APPENDIX: A

RECORD OF DECISION FOR
THE LEONARD CHEMICAL SUPERFUND SITE

SITE: Leonard
BREAK: 5.9
OTHER:

Leonard Chemical Company Superfund Site
Catawba, York County, South Carolina

RECORD OF DECISION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

U.S.E.P.A. - Region IV
Atlanta, Georgia
August 2001

PART 1: DECLARATION

A. SITE NAME AND LOCATION

Leonard Chemical Company
CERCLIS ID # SCD 991279324
Catawba, York County, South Carolina

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy action for the Leonard Chemical Company Site near Catawba, York County, South Carolina, which was chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the Administrative Record for this Site.

The State of South Carolina concurs with the selected remedy.

C. ASSESSMENT OF THE SITE

The response action selected in this Record of Decision is necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment from this Site.

D. DESCRIPTION OF THE SELECTED REMEDY

After the Leonard Chemical Company ceased operations, voluntary removal of the primary source materials from the Site by certain Potentially Responsible Parties (PRPs) was conducted with SCDHEC oversight. This final EPA response action addresses the principal threat remaining at the Site through remediation of subsurface soils to prevent further groundwater contamination.

The selected remedy consists of six (6) major components, which are briefly listed below:

- Institutional Controls (and Site Access Restrictions)

  Because site risk is based upon residential scenarios for both soil and groundwater, the selected remedy calls for institutional controls that will temporarily restrict the installation of wells for drinking water purposes, and temporarily restrict development of the site for residential purposes. Access to the site will be ensured through administrative and/or judicial tools. The existing perimeter fence and signs at the Site will be maintained to prevent site access by unauthorized parties.

- Excavation and Off-Site Disposal of Surface Soils

  Surface soils exceeding the risk-based Remediation Goals will be excavated and disposed at an appropriate landfill.

- In-situ Source Area Vacuum Extraction for Subsurface Soils

  The VOC contamination in the subsurface soil will be treated to limit further contamination of the groundwater.

- In-situ sparging (or in-well stripping) for Shallow Groundwater Impacts

  Compressed air or nitrogen will be injected into sparge wells throughout the source area plume. As air is released through the well screen and travels upward through the saturated zone, the VOCs present in the groundwater transfer into the vapor stream, thus reducing groundwater contamination.

- Installation of a Treatment Fence

  For deep groundwater impacts, an in-situ treatment fence will be installed to prevent off-site migration of groundwater contamination. The treatment fence will incorporate either in-situ sparging or the injection of a biodegradation enhancing compound.

- Groundwater Monitoring

  Groundwater monitoring will be conducted in shallow and deep aquifer zones to ensure the effectiveness of the treatment and barrier remedies.

E. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, but it will take more than five years to attain remedial action objectives and cleanup levels, a policy review will be conducted within five years of construction completion for the Site to ensure that the remedy is, or will be, protective of human health and the environment.

F. DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

- ☐ Chemicals of concern (COC) and their respective concentrations.
- ☐ Baseline risk represented by the COCs.
- ☐ Cleanup levels established for COCs and the basis for the levels.
- ☐ How source materials constituting principal threats are addressed.
- ☐ Current and reasonably anticipated future land use assumptions and current and future beneficial uses of groundwater considered in the baseline risk assessment and ROD.
- ☐ Potential land a ndwater use that will be available at the Site as a result of the Selected Remedy.
- ☐ Estimated capit ation and maintenance (O&M), and total present worth costs; discount rate; and the number of y er which the remedy cost estimates are projected.
- ☐ Key factor(s) th selecting the remedy.

G. AUTHORIZING SIG RE

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Date

Richard D. Green
Division Director
Waste Management Div
Region IV
United States Environm tection Agency

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PART 2: DECISION SUMMARY

A. SITE NAME, LOCATION, AND DESCRIPTION

A.1 Site Name and Location

The USEPA ID Number of the Leonard Chemical Company (LCC) Site is SCD991279324[1]. The Site is an inactive hazardous waste treatment and recovery facility located in the southeast portion of York County, South Carolina, approximately nine miles southeast of Rock Hill and one-half mile southeast of the community of Catawba on South Carolina Highway 697 (Figure A-1).

A.2 Lead and Support Agencies

The lead agency for the CERCLA regulatory response at the Site is the USEPA, Region 4, Atlanta, Georgia. The support agency for the CERCLA regulatory response at the Site is the Office of Environmental Quality Control, which is a part of the South Carolina Department of Health and Environmental Control (SCDHEC).

A.3 Source of Cleanup Monies

The funds for the response at the Site have largely come from the potentially responsible parties (PRPs), which include generators and users of the LCC facility. Pursuant to an Administrative Order on Consent (AOC) for a remedial investigation and feasibility study (RI/FS), effective December 13, 1990, the PRPs have agreed to pay the costs of the RI/FS as well as USEPA's oversight costs. USEPA intends to negotiate a consent decree for Remedial Design and Remedial Action (RD/RA) with the PRPs.

A.4 Site Type

The Site is an inactive hazardous waste treatment and recovery facility and has several different areas of contamination which have been addressed by past responses and will be subject to a final response action as a result of this ROD.

A.5 Brief Site Description

The LCC facility is an inactive hazardous waste treatment and recovery facility. The facility was comprised of three main operational areas, a truck turnaround/process area, a storage area, and a landfill. The remainder of the 7.1 acre site was wooded. The Site is located on Cureton Ferry Road, near Highway 697, approximately one-half mile east of Catawba in York County, SC. The Site is bordered on the east by Ferry Branch Creek, and on the north by a railroad track (Figure A-2). In general, the Site slopes from the southwest toward the northeast. Land use within a 3-mile radius is primarily for forestry, agricultural, and residential purposes.

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[1]The ID number was assigned under the CERCLA (Comprehensive Environmental Response, Compensation,and Liability Act) program, commonly referred to as Superfund.

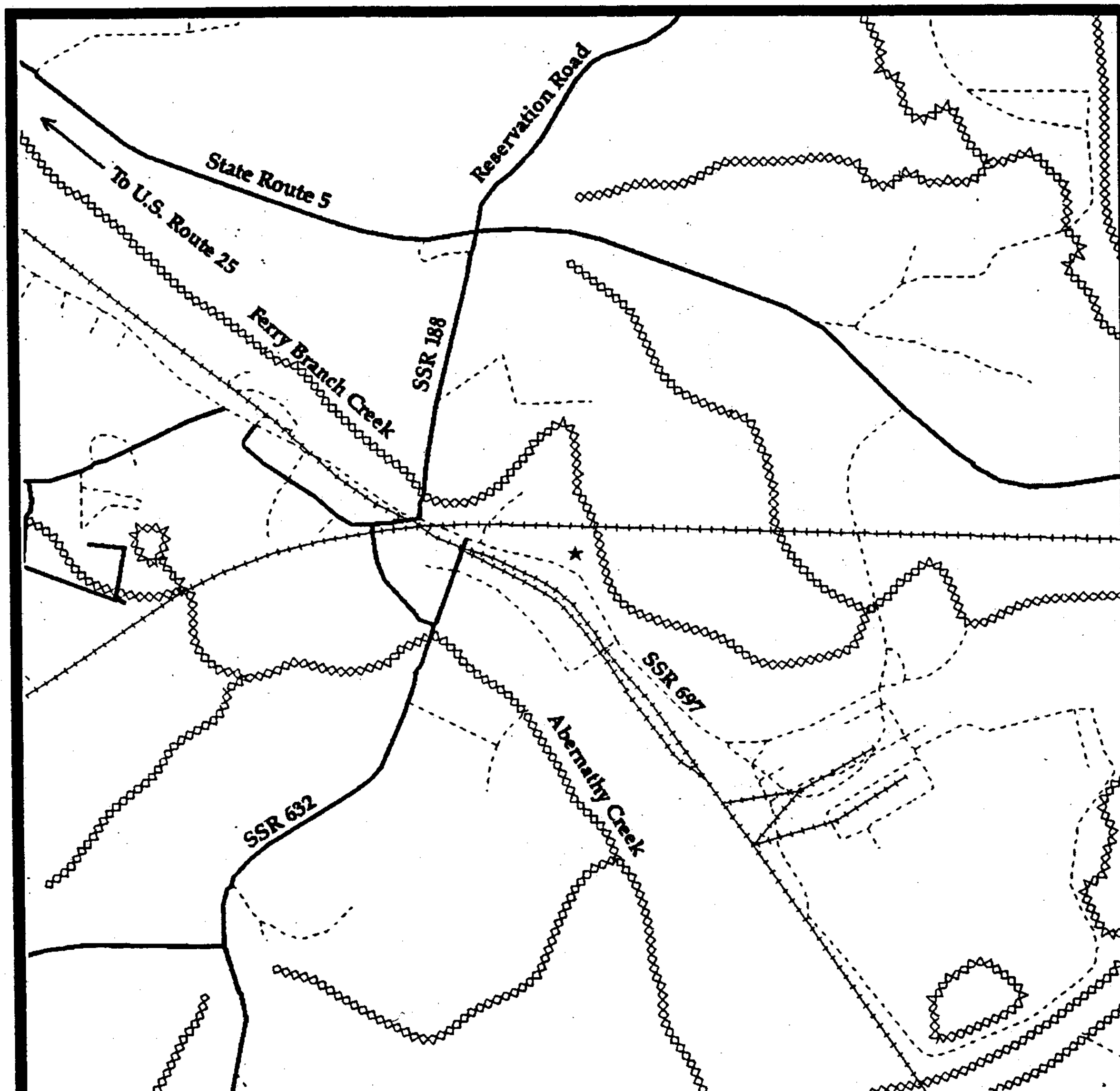


FIGURE A-1 Leonard Chemical Company Site Location

Site Located at

34d 51m 7s North Latitude
80d 54m 16s West Longitude

Map Scale

0 0.250 0.500 0.750 1 miles

Legend

★ Leonard Chemical Company Superfund Site
Major Roads
Minor Roads
Railroad
Stream

N S W E

U.S. EPA Region 4 - 05/18/2001

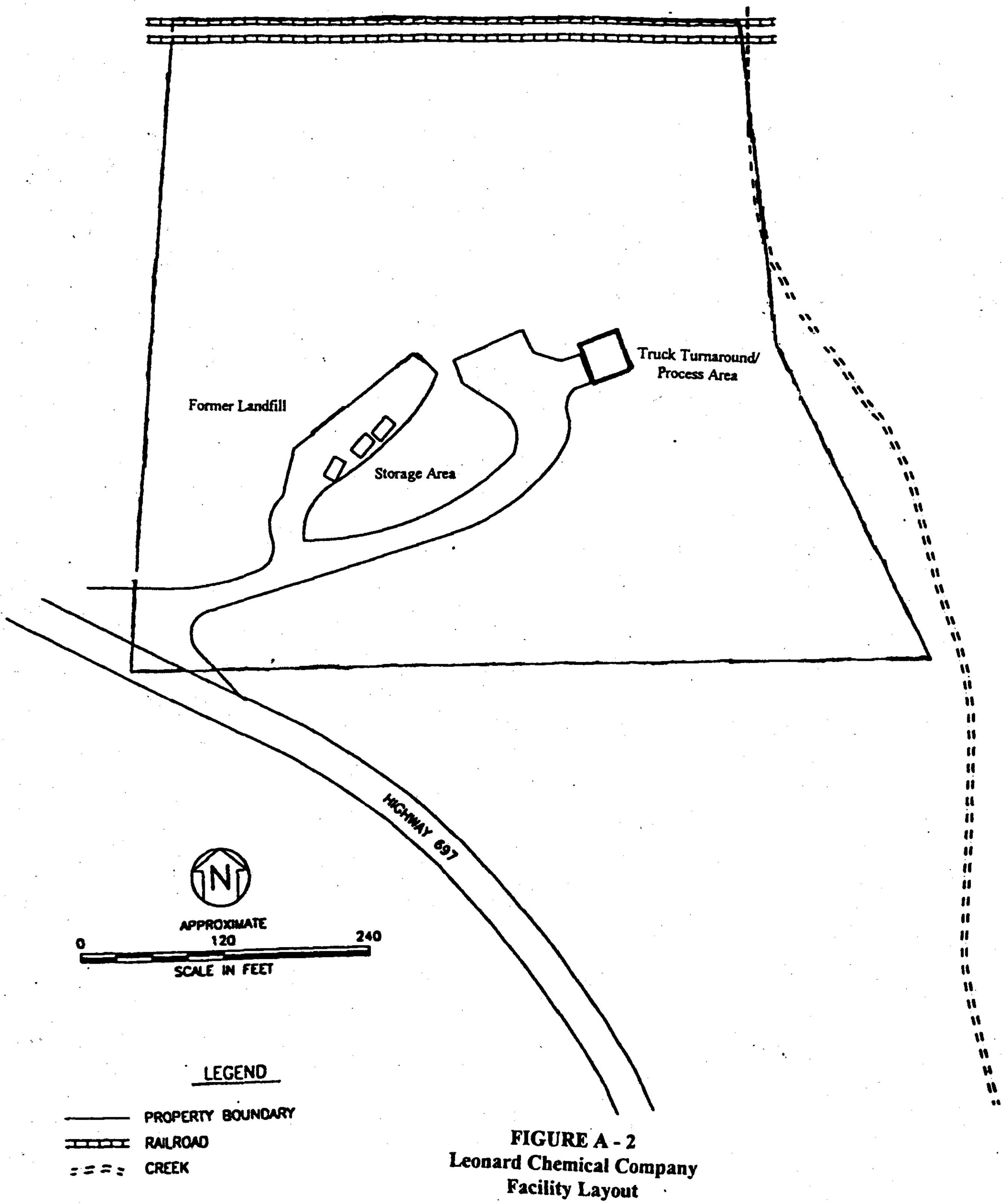


FIGURE A - 2
Leonard Chemical Company
Facility Layout

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

B.1 Site Activities Leading to Current Problems

The LCC Site was purchased from the Bowater Carolina Corporation in December 1965 by Mr. Lawrence Leonard. Leonard Chemical Company was established in May 1966 to provide waste solvent treatment, storage and disposal services. A concrete pad at the Site supported a steam generator, a ThinFilm evaporator, used for solvent distillation, and several storage tanks and trucks. The recovery method involved distillation of solvents which resulted in the generation of residues or still bottoms, from the cleaning (and possibly other) processes, deposited onsite in the still process area, landfill, and drum storage area. Some wastes were also incinerated, and the ash was disposed onsite. In the area of the landfill, wastes were trucked to the area in open top containers, then dumped down the slope of the ravine. The truck turnaround area is immediately down gradient from the process areas. The owner of the Leonard Chemical Company used soil, and later waste material, for fill to create a level platform for unloading shipments.

Contaminants evaluated and addressed under this ROD include, but are not limited to: tetrachloroethene (PCE), trichloroethene (TCE), toluene, methylene chloride, methyl ethyl ketone, acetone, lead (Pb), copper (Cu), cadmium (Cd), bis (2-ethylhexyl) phthalate, and Arochlor 1260.

B.2 State and Federal Investigations/Enforcement History

In September 1977, SCDHEC cited LCC for improper waste handling under the South Carolina Pollution Control Act and subsequent Hazardous Waste Management Regulations. On September 26, 1980, LCC applied for hazardous waste treatment facility permit under RCRA but only mentioned treatment by incineration, not distillation or other solvent recovery. In May 1982, SCDHEC issued an administrative order directing LCC, the owner/operator of the Site, to implement corrective measures to ensure compliance with the South Carolina Hazardous Waste Management Act. In May 1983, LCC was ordered to stop operations by a court order from the Court of Common Pleas, York County for failure to comply with applicable state statutes.

In November 1982, SCDHEC and certain generator PRPs of waste at LCC began negotiations for a voluntary clean-up action. A surficial cleanup was conducted in the spring of 1983. Approximately 3000 drums of solvents, volatiles, and inks, and 600 cubic yards of soil were removed.

The LCC Site was proposed for inclusion on the National Priorities List (NPL), as defined in Section 105 of CERCLA, as amended by SARA (P.L. 99-499), on September 8, 1983. The LCC Site was listed final on the NPL on September 21, 1984.

Following the voluntary clean-up action, certain PRPs formed a committee, the LCC Generators Group, to facilitate cleanup and negotiations with state and federal authorities. A contractor for the LCC Generators Group conducted a site assessment in November 1984. In April 1985, EPA notified SCDHEC that this would NOT be adequate for a Remedial Investigation, because surface water and groundwater were not addressed.

On September 17, 1986, SCDHEC, jointly with EPA, formally requested the Part B RCRA Permit from LCC. LCC unsuccessfully applied for a Part B RCRA Permit. On August 10, 1988, SCDHEC denied LCC's Part B Permit application after LCC failed to properly complete the application by July 26, 1988, as specified in SCDHEC's May 23, 1988 letter. The denial of the permit and revocation of interim status did not relieve LCC of responsibility for closure and post-closure care of the Site. Mr. Leonard appealed this decision. No final resolution had been achieved at the time this ROD was issued.

A Visual Site Inspection and Preliminary Assessment were conducted by an EPA contractor and finalized November 16, 1989. In December 1990, the LCC Generators Group signed an Administrative Order on Consent (AOC) to perform an RI/FS. The LCC Generators Group, through their contractors, has completed the RI/FS and has submitted the Final RI and FS Reports. The USEPA has overseen all RI/FS and related Site study activities. The Baseline Risk Assessment (BRA) was conducted by USEPA and completed in July 1994. The RI/FS and BRA support this Final ROD.

C. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The U.S. Environmental Protection Agency (USEPA) conducted interviews in the Catawba area of York County in April 1991 to solicit concerns and information about the LCC Site. Residents, environmental groups, media contacts, and nearby residents were interviewed and, where requested, added to the Site mailing list. Based on the interviews, a community relations plan was developed by EPA in June 1991. Between 1991 and the notification of the public meeting to be held on March 29, 2001, EPA received no written comments or concerns from anyone other than regulatory authorities, potentially responsible parties, and their contractors, regarding the LCC Site.

The RI/FS and Proposed Plan for the LCC Site near Catawba, South Carolina were made available to the public in March 2001. They can be found in the Administrative Record file and the information repository maintained at the EPA Docket Room in Region 4 and at the York County Public Library. The notice of the availability of these two documents was published in the Rock Hill *Herald* on March 15, 2001. A public comment period was held from March 19, 2001 to April 20, 2001. In addition, a public meeting was held on March 29, 2001 to present the Proposed Plan to a broader community audience than those that had already been involved at the Site. At this meeting, representatives from EPA and the SCDHEC answered questions about problems at the Site and the remedial alternatives. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

D. SCOPE AND ROLE OF RESPONSE ACTIONS

The LCC Site resulted from one primary operation, the on-site treatment and disposal of solvents and waste sludges. Incineration, distillation, and disposal all occurred in a three (3) to four (4) acre area. As a result, the Site represents a single operable unit and will be addressed with a single site wide remedy presented in this Record of Decision.

E. SITE CHARACTERISTICS

E.1 <u>Physical Characteristics</u>

The LCC Site is located on a wooded 7.1-acre tract of land. Site structures include three metal sheds, several abandoned pieces of equipment, and a concrete pad where a solvent distillation column was located. The Site is comprised of three principal former operations areas: the truck turn-around area, the storage area, and the landfill area. The truck turn-around area included the distillation column and filtration processes and was where trucks turned around to exit the Site. The storage area contained several above ground tanks used for storage of incoming solvents and distilled products. The landfill area was used to dispose of drums, distillation sludges, and other debris.

The Site is bounded on the north side by a rail line, on the east side by Ferry Branch Creek, with vacant wooded land beyond, on the west side by Cureton Ferry Road, and on the south side by vacant wooded land. The Site perimeter is presently fenced (Figures A - 1 and A-2).

Residual soils and alluvium can be found at the LCC Site between 0 and 65 feet below ground surface (bgs). The residual soils consist mainly of stiff, yellowish to reddish-brown clayey silts. As the residual soils grade into the saprolite with depth, the soils become harder and grayer and contain more rock fragments. The thickness of the alluvium onsite varies from 0 to 10 feet bgs. The alluvial soils are found mainly along Ferry Branch.

The Site hydrogeology consists of three general zones, all of which are interconnected: an upper zone of clayey and silty saprolite; a middle or transitional zone of partially weathered rock (PWR) which contains alternating zones of clayey and silty material, partially decomposed rock, and competent rock; and a third zone containing competent fractured bedrock.

The water table occurs in the upper zone at depths ranging from 40 feet bgs in the western portion of the Site, to approximately 20 ft bgs in the central portion of the Site, to 6 ft bgs in the eastern portion of the Site near Ferry Branch. Unsaturated zone soils generally consist of silty and clayey saprolite.

Groundwater flow in the saprolite is generally from west to east across the Site with groundwater discharge to Ferry Branch at the eastern boundary of the Site. Ferry Branch serves as a hydraulic boundary to shallow groundwater and precludes the movement of compounds in shallow groundwater beyond the Site's eastern boundary prior to groundwater discharge to the creek in areas downstream of the Site.

Surface water drainage at the LCC Site generally occurs as sheet flow trending east and southeast toward Ferry Branch. Surface water drainage also flows from the former landfill area of the Site toward the north into a swale that trends east and eventually drains into Ferry Branch. Ferry Branch flows generally east and southeast, but with southward flow adjacent to the Site, and eventually ends at its confluence with the Catawba River approximately 2.4 miles downstream of the Site. The Catawba River flows south into Chester County.

Groundwater flow in the deeper bedrock is also generally from west to east across the Site, with groundwater in the deeper zone also discharging to Ferry Branch at the eastern boundary of the Site. There is a zone of higher bedrock fracturing which coincides with the location of Ferry Branch that allows for some bedrock groundwater transport parallel to Ferry Branch (underflow) prior to discharge to the creek at a downstream location.

All private wells in the vicinity of the Site appear to be located upgradient of the Site, and are, therefore, highly unlikely to be impacted by site-related contamination.

The geographical coordinates of the LCC Site are 34° 51' 7" N latitude and 080° 54'16" W longitude.

There are no known areas of archeological or historical importance on or immediately near the Site.

E.2. Nature and Extent of Contamination

The Remedial Investigation determined the following regarding the nature and extent of contamination at the LCC Site:

Surface soils are impacted with volatile organic compounds (VOCs) and other chemicals in three primary areas, including the truck turnaround area, the former storage area, and the former landfill area. The most prevalent VOC constituents include tetrachloroethene (PCE), trichloroethene (TCE), and toluene. Other chemicals in the surface soil include lead, cadmium, chromium, bis 2-ethylhexyl phthalate, and Arochlor 1260.

Subsurface soils are contaminated primarily with VOCs, including PCE, TCE, and toluene. The largest volume of impacted soils at the Site were found in and just north of the former storage area. Subsurface soils are a continuing source of groundwater contamination at the Site.

VOCs are the primary chemicals of concern in groundwater. Groundwater monitoring has been conducted in the shallow saprolite aquifer and in the bedrock, including the PWR zone. Analytical data from 1991-92 and 1997-98 sampling events indicate a chlorinated VOC plume extending from the center of the Site to Ferry Branch and continuing south parallel with Ferry Branch. Chemicals of concern include PCE, TCE, methyl ethyl ketone, acetone, and toluene. Metals do not appear to be present at levels of concern in the groundwater.

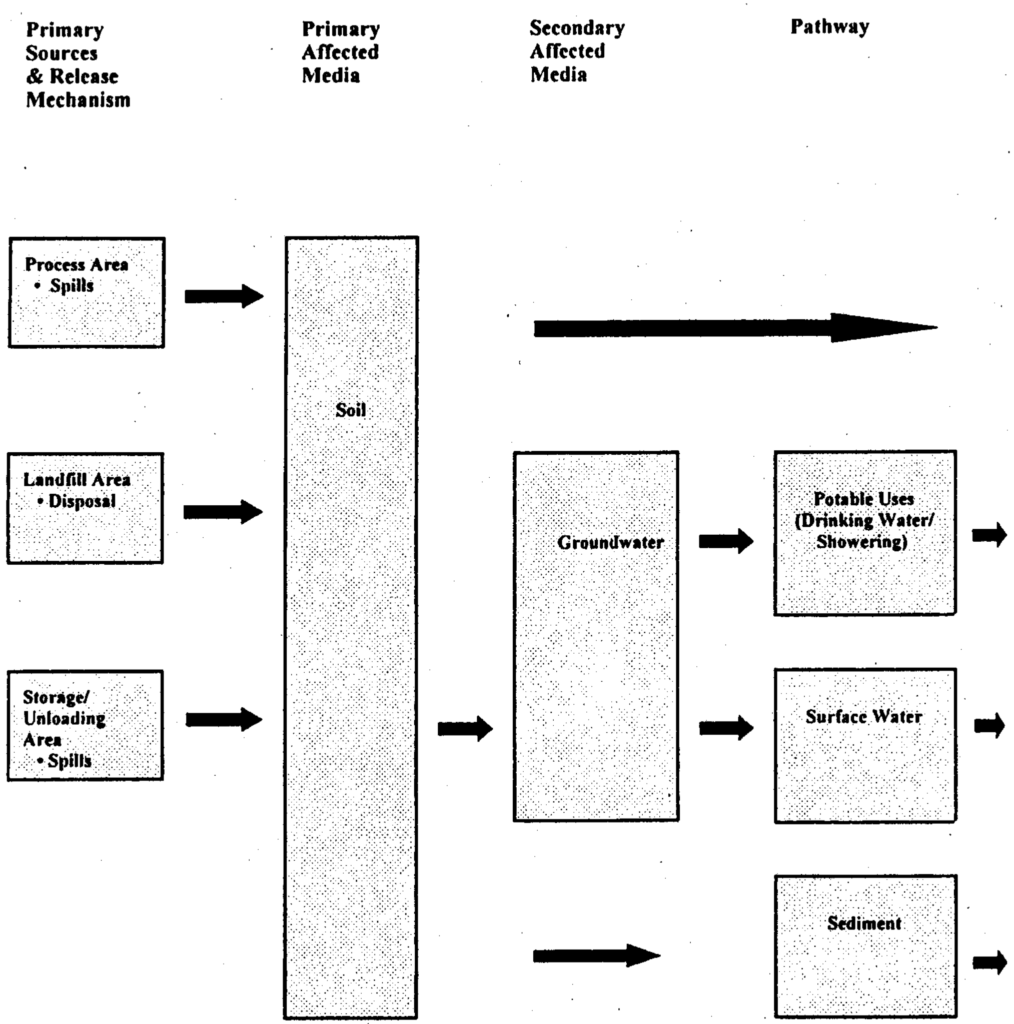
Surface water and sediments in Ferry Branch do not appear to be contaminated at levels that exceed applicable standards. Only trace amounts of VOCs, including PCE and TCE, were detected in surface water and sediment samples collected.

E.3 Conceptual Site Model

The Conceptual Site Model (CSM) upon which the risk assessment and response action are based is depicted in Figure E - 1. The CSM is the map of the exposure pathways at the Site which dictates the focus of the ROD's remedy analysis and guides the focus of remediation efforts in the selected remedy. The CSM ties the potential sources of contamination (i.e., releases) to the pathways for contaminant migration, and then to the receptors associated with those pathways.

The major contamination stems from spills and disposal, resulting in the original soil contamination. From the soil contamination, groundwater may become contaminated. Groundwater flow at the Site appears to discharge to Ferry Branch Creek, thereby potentially releasing contaminants into the surface water.

Potential exposure targets addressed are current adult site visitors or trespassers, future adult site workers, future adult residents, and future adolescent residents. The CSM notes how each potential human receptor, or exposure target, may be affected (i.e. - through ingestion, inhalation, or dermal contact).



	Receptor				
	Human			Biota	
Exposure Route	Site Visitor/ Trespasser	Worker	Resident	Terrestrial	Aquatic
Ingestion	•	•	•	•	
Inhalation	•	•	•		
Dermal Contact	•	•	•	•	
Ingestion		•	•		
Inhalation		•	•		
Dermal Contact		•	•		
Ingestion				•	•
Inhalation					
Dermal Contact				•	•
Ingestion				•	•
Inhalation					
Dermal Contact	•			•	•

Figure E-1 - Conceptual Site Model

F. CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

The LCC Site is located in a rural area, approximately one-half mile east of the community of Catawba, South Carolina. At the time EPA conducted the BRA (1994), the population within a 1-mile radius of the Site was approximately 638 persons, and within a 3-mile radius was estimated to be approximately 5,018 persons. The nearest residence was located 570 feet southwest from the main entrance gate. According to the Preliminary Health Assessment for LCC (SCDHEC 1988), four households were located within 600 feet south of the Site, and a nursing home is located within 1-mile south of the Site.

At the time of the BRA, within a 3-mile radius of the Site there were approximately 1,487 homes that utilized private wells, all of which were screened in the bedrock zone of the aquifer. The residents without private wells used either non-community or community public water systems. There were 11 non-community public water systems and 1 community public water system located within a 3-mile radius of the Site. These were all served by groundwater wells. There were no homes (and therefore no wells) located downgradient (east) of the Site. The nearest private well was located southwest of the Site within 620 feet of the main gate. This well was used by 20 people. The Catawba Community Center was located approximately 0.75 mile southwest of the Site. The community center obtained its water from two wells that were screened at depths of 110 and 225 feet bgs. Shortly after EPA's BRA was finalized, York County extended the municipal water system, which is supplied by Lake Wylie, along Cureton Ferry Road. The Bowater Carolina Corporation is located within 0.8 mile to the southeast and is served by the municipal system for drinking water for their approximately 1500 employees. Bowater obtains process water directly from the Catawba River. The only surface water intake is located within 3 miles downstream of the Site, along the west bank of the Catawba River.

Prior to 1965, the Site property was owned by Bowater Paper Mill. From 1965 to 1982, the property was used for industrial solvent recycling operations by Leonard Chemical Company (LCC).

As part of the Remedial Investigation, EPA conducted a zoning investigation which was completed in September 1997. According to this investigation, the LCC Site and surrounding area were free from zoning prior to 1986. In 1986 (after LCC had ceased operations), York County initiated zoning boundaries throughout the county. There are currently no plans to re-zone this area. According to York County tax map 757-1, the LCC Site is currently zoned as a rural development district (RUD). This type of zoning prohibits development of industry in the designated area, and is intended to protect and preserve areas of the county which are rural in character and use, and discourage rapid growth. Residential development on large tracts is an integral part of this RUD zoning ordinance. RUD allows limited commercial/industrial land use only through special exceptions which require a public hearing. Exceptions include veterinary kennels, animal auction houses, slaughter houses, retail stores, gasoline stations, and automobile garages.

Because the LCC Site is bordered by a differently zoned region, the investigation included the bordering zone as well. According to York County tax map 759-15, the Bowater Carolina Corporation Paper Mill and commercial forest, which covers approximately 781 acres, and borders the eastern edge of the LCC Site, is zoned as an Industrial Development District (ID). ID zoning promotes industrial/commercial development in the designated area.

Real estate transactions in the Catawba area are limited. Further residential development will likely remain quite limited unless another large industry locates in the Catawba area. At this time, any residential development which occurs at or around the Site through a developer or builder will be required to hook up to the municipal water system. However, private well installation is not restricted. Residents who build their own homes or place mobile homes on the property would be allowed under the SCDHEC Private Well Program to install their own drinking water wells.

G. SUMMARY OF SITE RISKS

G.1 Summary of Human Health Risk Assessment

The baseline risk assessment estimates what risks the Site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. Because the BRA was finalized by EPA in July 1994, the risks were re-calculated based on up-to-date toxicity values. The updated calculations can be found in the Administrative Record for the Site. This section of the ROD summarizes the results of the baseline risk assessment for the Site, using the current toxicity calculations.

G.1.1 Identification of Chemicals of Concern

Table G - 1 presents the chemicals of potential concern (COCs) and exposure point concentration for each of the COCs detected in each medium (i.e., the concentration that will be used to estimate the exposure and risk from each COC in the medium). The table includes the range of concentrations detected for each COC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the Site), the exposure point concentration (EPC), and how the EPC was derived. Table G - 1 indicates that chromium, lead, and bis(2-ethylhexyl)phthalate are the most commonly detected COCs in soil at the Site, with lead, manganese, and zinc being detected most frequently in groundwater. Zinc and tetrachloroethene are the most frequently detected constituents in sediment and surface water at the Site.. The maximum concentration detected was used as the default exposure point concentration for all constituents due to the limited amount of sample data.

G.1.2 Exposure Assessment

The exposure assessment identified potential exposure pathways and quantifies the magnitude, frequency and duration of reasonable maximum exposure. The LCC baseline risk assessment utilized the following current and future industrial scenario exposures, which have a reasonable likelihood of occurring, in the evaluation of Site risks.

- Exposures to COPCs in the surface soils by current site visitor/trespasser
- Exposures to COPCs in the surface soil by future adult worker and future resident
- Exposures to COPCs in the groundwater by future resident and future worker
- Exposures to COPCs in the sediments by future resident and future worker

Health risks posed by COPCs were determined by the level of exposure (i.e., the magnitude, frequency and duration of exposure) and the toxicity associated with these levels.

G.1.3 Toxicity Assessment

The toxicity assessment addresses the potential for a COPC to cause adverse effects in exposed populations and estimates the relationship between extent of exposure and extent of toxic injury (i.e. dose-response relationship.). To assist in estimating potential health effects of chemical exposures, The USEPA has developed toxicity values which reflect the magnitude of the adverse noncarcinogenic and carcinogenic effects from exposure to specific chemicals. Abbreviated descriptions of the development of the toxicity values follow.

Table G-1 Summary of Chemicals of Potential Concern and Exposure Point Concentrations						
Medium: Soil					**Units:**	mg/kg
Exposure Medium: Surface Soil						
Exposure Point	**Chemical of Concern**	**Detected Concentration**		**Detection Frequency**	**Exposure Point Concentration**	**Statistical Measure**
		Minimum	**Maximum**			
Landfill Area	Antimony	52.1	52.1	½	52.1	Max
	Arochlor	33	33	½	33	Max
	Arsenic	1.52	2.38	2/2	2.38	Max
	Barium	39.3	905	2/2	905	Max
	Bis(2-ethylhexyl)phthalate	1100	1100	½	1100	Max
	Cadmium	146	146	½	146	Max
	Chromium	37.5	708	2/2	708	Max
	Copper	22.2	381	2/2	381	Max
	Di-n-butyl phthalate	360	360	½	360	Max
	Lead	37.3	4280	2/2	4280	Max
	1,1,2-Trichloroethane	22	22	½	22	Max
Storage Areas	Arochlor	0.3	0.3	½	0.3	Max
	Barium	40.3	41	2/2	41	Max
	Bis(2-ethylhexyl)phthalate	0.91	2.8	2/2	2.8	Max
	Cadmium	5.52	5.52	½	5.52	Max
	Chromium	40.1	72.9	2/2	72.9	Max
	Lead	85.8	757	2/2	757	Max
	Mercury	0.1	0.11	2/2	0.11	Max
	Vanadium	40	164	2/2	164	Max
Truck Turn-Around/ Process Area	Antimony	59.5	850	2/4	850	Max
	Arochlor	2.8	11	2/4	11	Max
	Bis(2-ethylhexyl)phthalate	6.4	2600	4/4	2600	Max
	Cadmium	3.36	96	3/4	96	Max
	Chromium	55.7	788	4/4	788	Max
	Copper	42.1	3280	4/4	3280	Max
	Lead	200	4060	4/4	4060	Max
	Methyl ethyl ketone	4800	4800	1/4	4800	Max
	Methylene Chloride	21	1000	3/4	1000	Max
	Tetrachloroethene	260	7700	2/4	7700	Max
	Toluene	0.013	22000	3/4	22000	Max
	Trichloroethene	6700	6700	1/4	6700	Max
	1,1,2-Trichloroethane	960	7600	2/4	7600	Max
Sediment Contact	Nickel	0.92	0.92	½	0.92	Max
	Tetrachloroethene	0.002	0.007	2/2	0.007	Max
	Trichloroethene	0.002	0.002	½	0.002	Max
	Zinc	7.18	9.44	2/2	9.44	Max
Medium: Water					**Units:**	mg/L
Exposure Medium: Groundwater						
Shallow Ground Water	Acetone	27	27	1/10	27	Max
	Lead	0.00252	0.011	10/10	0.011	Max
	Manganese	0.0447	8.92	7/7	8.92	Max
	Methyl Ethyl Ketone	140	140	1/10	140	Max
	Methylene Chloride	0.004	12	5/10	12	Max
	Methyl Isobutyl Ketone	0.011	13	2/10	13	Max
	Tetrachloroethene	0.002	11	5/10	11	Max
	Toluene	0.008	18	2/10	18	Max
	Trichloroethene	0.001	2.4	6/10	2.4	Max
	Vinyl Chloride	2.7	27	1/10	2.7	Max
	Zinc	0.0114	0.155	7/7	0.155	Max

Table G-1 Summary of Chemical of Concern and Exposure Point Concentrations						
Medium: Water **Exposure Medium:** Groundwater					**Units:** mg/kg	
Exposure Point	**Chemical of Concern**	**Detected Concentration**		**Detection Frequency**	**Exposure Point Concentration**	**Statistical Measure**
		Minimum	**Maximum**			
Shallow Groundwater (continued)	1,1,2-Trichloroethane	0.004	9.8	3/10	9.8	Max
	1,2-Dichloroethene	0.005	0.005	½	0.005	Max
	1,2-Dichloroethane	0.81	0.81	1/10	0.81	Max
Deep Ground Water	Manganese	0.00428	0.213	5/5	0.213	Max
	Methylene Chloride	0.003	0.004	3/7	0.004	Max
	Tetrachloroethene	0.002	1	6/7	1	Max
	Trichloroethene	0.002	0.32	6/7	0.32	Max
	1,1,2-Trichloroethane	0.078	0.078	1/7	0.078	Max
	1,2-Dichloroethene	0.002	0.002	1/7	0.002	Max
Medium: Water **Exposure Medium:** Surface Water					**Units:** mg/L	
Surface Water Contact	Acetone	0.012	0.012	½	0.012	Max
	Bis(2-ethylhexyl)phthalate	0.029	0.029	½	0.029	Max
	Methyl isobutyl ketone	0.01	0.01	½	0.01	Max
	Tetrachloroethene	0.007	0.007	½	0.007	Max
	Toluene	0.002	0.002	½	0.002	Max
	Trichloroethene	0.003	0.003	½	0.003	Max
	Zinc	0.011	0.013	2/2	0.013	Max
	1,2-Dichloroethene	0.002	0.002	½	0.002	Max

Notes:
Max - Exposure point concentrations are based on the maximum detected concentrations since the sample sizes were less than 20.

G.1.3.1 *Noncarcinogenic Effects*

Chemicals that give rise to toxic endpoints other than cancer and gene mutations are often referred to as "systemic toxicants" because of their effects on the function of various organ systems. Chemicals considered to be carcinogenic can also exhibit systemic toxicity effects. For many noncarcinogenic effects, protective mechanisms (i.e., exposure or dose thresholds) are believed to exist that must be overcome before an adverse effect is manifested. This characteristic distinguishes systemic toxicants from carcinogens and mutagens which are often treated as acting without a distinct threshold. As a result, a range of exposure exists from zero to some finite value that can be tolerated with essentially no chance of the organism expressing adverse effects. In developing toxicity values for evaluating noncarcinogenic effects, the standard approach is to identify the upper bound of this tolerance range or threshold and to establish the toxicity values based on this threshold.

The toxicity value most often used in evaluating noncarcinogenic effects is a Reference Dose (RfD) for oral or dermal exposure, or Reference Concentration (RfC) for inhalation exposure. Various types of RfDs/RfCs are available, depending on (1) the exposure route of concern (e.g., oral or inhalation), (2) the critical effect of the chemical (e.g., developmental or other), and (3) the length of exposure being evaluated (e.g., chronic or subchronic).

Reference Doses (RfDs) have been developed by USEPA for indicating the potential for adverse health effects from exposure to contaminant(s) of concern exhibiting noncarcinogenic effects. A chronic RfD/RfC is defined as an estimate of a daily exposure level for the human population that is likely to be without appreciable risk of deleterious effects during a lifetime. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure limits for humans, including sensitive individuals. Estimated intakes of contaminant(s) of concern from environmental media (e.g., the amount of a contaminant(s) of concern ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). Chronic RfDs/RfCs are specifically developed to be protective for long-term exposures, i.e., seven [7] years to a lifetime (seventy [70] years). All exposures, except childhood exposures, in this preliminary risk evaluation are assumed to be long-term. The chronic RfDs/RfCs for the chemicals of concern at this Site are presented in Table G - 2 are derived from USEPA's Integrated Risk Information System (IRIS). The oral and inhalation RfDs shown in Table G -2 are derived from USEPA's Health Effects Assessment Summary Tables (HEAST).

G.1.3.2 *Carcinogenic Effects*

Carcinogenesis, unlike many noncarcinogenic health effects, is generally thought to be a non-threshold effect. In other words, USEPA assumes that a small number of molecular events can cause changes in a single cell that can lead to uncontrolled cellular growth. This hypothesized mechanism for carcinogenesis is referred to as "non-threshold", because there is believed to be essentially no level of exposure to such a chemical that does not pose a finite probability of generating a carcinogenic response.

To evaluate carcinogenic effects, USEPA uses a two-part evaluation in which the chemical is first assigned a weight-of-evidence classification, and then a Carcinogenic Slope Factor (CSF) is calculated. These Indices can be derived for either oral or inhalation exposures. The weight-of-evidence classification is based upon an evaluation of the available data to determine the likelihood that the chemical is a human carcinogen. The following list shows the EPA cancer classes with an explanation of each (based on the EPA 1986 Cancer Guidelines).

USEPA Weight-of-Evidence
Classification System for Carcinogenicity

Group	Description
A	Human carcinogen
B	Probable human carcinogen
B1	Limited data are available
B2	Sufficient evidence in animals and inadequate or no evidence in humans
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity for humans

The Slope Factor (SF) quantitatively defines the relationship between the dose and the response. SFs have been developed by USEPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals of concern. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The Slope Factor is generally expressed as a plausible upper-bound estimate of the probability of response occurring per unit of chemical. The term "upper-bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope Factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-animal extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). The Carcinogenic Slope Factors for the chemicals of concern at this Site are presented in Table G - 2A. These Slope Factors were derived from USEPA's Health Effects

Assessment Summary Tables (HEAST).

These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-06). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a reasonable maximum estimate, an individual has a one in one million (1 in 1,000,000) chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

G.1.3.3 *Dermal Exposures*

No RfDs or CSFs have been derived for dermal absorption. Risks associated with dermal exposures may be evaluated with Oral Absorbed Dose RfDs or Oral Absorbed Slope Factors after dermal exposures are converted to their respective absorbed dose. Dermal exposures were adjusted to absorbed dose estimates by assuming that the contaminants permeate skin at chemical-specific permeability rates. Oral RfDs and CSFs were also adjusted by the appropriate oral absorption rate, which gives an Absorbed Dose RfD or Absorbed Dose CSF. The Dermal Absorbed Dose intakes can then be compared to Absorbed Dose toxicity values, as described in the Risk Assessment Guidance for Superfund (RAGS).

G.1.3.4 *Toxicity Assessment*

Slope factors (SFs) have been developed by USEPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminant(s) of concern. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope Factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Reference doses (RfDs) have been developed by USEPA for indicating the potential for adverse health effects from exposure to contaminant(s) of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of contaminant(s) of concern from environmental media (e.g., the amount of a contaminant(s) of concern ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Tables G-2A and G-2B provide risk information which is relevant to the chemicals of concern in both soil and groundwater. In both tables, the information is based upon toxicity values which have been updated since the BRA.

Table G - 2A provides carcinogenic risk information. At this time, slope factors are not available for the dermal route of exposure. Thus, the dermal slope factors used in the assessment have been extrapolated from oral values. An adjustment factor is sometimes applied, and is dependent upon how well the chemical is absorbed via the oral route. Adjustments are particularly important for chemicals with less than 50% absorption via the ingestion route. For contaminants which did not require adjustment, the oral factors presented above were used as the dermal carcinogenic slope factors.

Table G - 2B provides non-carcinogenic risk information. At least eleven (11) of the COPCs have toxicity data indicating their potential for adverse non-carcinogenic health effects in humans. Chronic toxicity data available for COPCs have been used to develop oral reference doses (RfDs). As was the case for the carcinogenic data, dermal RfDs can be extrapolated from the oral RfDs applying an adjustment factor as appropriate.

G.1.4 Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where:

risk = a unitless probability (e.g., 2×10^{-5})
CDI = chronic daily intake averaged over 70 years (mg/kg-day); and
SF = slope-factor, expressed as $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1 E - 06). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun.

The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPA's generally acceptable excess lifetime risk range for site-related exposures is 10^{-4} to 10^{-6}.

Appendix A provides carcinogenic risk estimates for the significant routes of exposure, and Table G-3 provides a risk summary. These risk estimates are based upon a reasonable maximum exposure and were developed by taking into account various conservative assumptions about the frequency and duration of an individual's exposure to soil and groundwater, as well as the toxicity of the COCs. For example, the total carcinogenic risk from direct exposure to soil, dust, sediment, and groundwater to a Child Resident is estimated to be 2E-02. The COPCs contributing most to this risk level are PCBs and VOCs in soil and VOCs (e.g. - PCE) in groundwater. This risk level indicates that if no clean-up is taken, an individual would have an unacceptably increased probability of developing cancer as a result of site-related exposure to COCs based upon reasonable maximum exposures (RMEs).

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1.0 indicates that a receptor's dose of a single contaminant is less that the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same
mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. By adding the HQs for all contaminant(s) of concern that effect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. An HI < 1.0 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI > 1.0 indicates that site-related exposures may present a risk to human health.

Table G-2A
Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Dermal Cancer Slope Factor[1]	Slope Factor Units	Weight of Evidence/ Cancer Guideline	Source	Date
Arsenic	1.5E+000	95%	1.6E+000	(mg/kg-day)-1	A	IRIS	04/10/1998
Arochlor 1254	2.0E+000	50%	4.0E+000	(mg/kg-day)-1	B2	IRIS	06/01/1997
Bis(2-ethylhexyl)phthalate	1.4E-002	55%	2.5E-002	(mg/kg-day)-1	B2	IRIS	02/01/1993
Cadmium	NA	NA	NA	NA	B1	NA	NA
Chromium	NA	NA	NA	NA	D	NA	NA
Methylene Chloride	7.5E-003	80%	9.4E-003	(mg/kg-day)-1	B2	IRIS	02/01/1995
Nickel	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	5.2E-002	100%	5.2E-002	(mg/kg-day)-1	NA	NCEA	09/01/1995
Trichloroethene	1.1E-002	100%	1.1E-002	(mg/kg-day)-1	NA	NCEA	09/06/1995
Vinyl Chloride	7.2E-001	100%	7.2E-001	(mg/kg-day)-1	A	IRIS	08/07/2000
1,1,2-Trichloroethane	5.7E-002	81%	7.0E-002	(mg/kg-day)-1	C	IRIS	02/01/1994
1,1-Dichloroethene	6.0E-001	80%	7.5E-001	(mg/kg-day)-1	C	IRIS	02/01/1998
1,2-Dichloroethane	9.1E-002	100%	9.1E-002	(mg/kg-day)-1	B2	IRIS	01/01/1991

Pathway: Inhalation

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Slope Factor	Slope Factor Units	Weight of Evidence/Cancer Guideline	Source
Arsenic	4.3E-003	(ug/m3)-1	3500	1.5E+001	(mg/kg-day)-1	A	IRIS
Arochlor 1254	NA	NA	NA	NA	NA	B2	NA
Beryllium	2.4E-003	(ug/m3)-1	3500	8.4E+000	(mg/kg-day)-1	B1	IRIS
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	B2	NA
Cadmium	1.8E-003	(ug/m3)-1	3500	6.3E+000	(mg/kg-day)-1	B1	IRIS
Chromium	1.2E-002	(ug/m3)-1	3500	4.2E+001	(mg/kg-day)-1	A	IRIS
Methylene Chloride	4.7E-007	(ug/m3)-1	3500	1.6E-003	(mg/kg-day)-1	B2	IRIS
Nickel	2.4E-004	(ug/m3)-1	3500	8.4E-001	(mg/kg-day)-1	A	IRIS
Tetrachloroethene	5.8E-007	(ug/m3)-1	3500	2.0E-003	(mg/kg-day)-1	NA	NCEA
Trichloroethene	1.7E-006	(ug/m3)-1	3500	6.0E-003	(mg/kg-day)-1	NA	NCEA
Vinyl Chloride	4.4E-006	(ug/m3)-1	3500	1.5E-002	(mg/kg-day)-1	A	IRIS
1,1,2-Trichloroethane	1.6E-005	(ug/m3)-1	3500	5.6E-002	(mg/kg-day)-1	C	IRIS
1,1-Dichloroethene	5.0E-005	(ug/m3)-1	3500	1.8E-001	(mg/kg-day)-1	C	IRIS
1,2-Dichloroethane	2.6E-005	(ug/m3)-1	3500	9.1E-002	(mg/kg-day)-1	B2	IRIS

Table G-2B Non-Cancer Toxicity Data Summary										
Pathway: Ingestion, Dermal										
Chemical of Concern	Chronic/ Subchronic	Oral RfD		Oral to Adjusted Dermal RfD		Primary Target Organ	Combined Uncertainty /Modifying Factor	Sources of RfD/ Target Organ	Dates of RfD/ Target Organ
		Value	Units	Dermal Adjustment Factor	Adjusted				
Acetone	Chronic	1.0E-001	mg/kg-day	83%	8.3E-002	Liver, Kidney	1000	IRIS	08/01/1993
Antimony	Chronic	4.0E-004	mg/kg-day	1%	4.0E-006	Blood	1000	IRIS	02/01/1991
Arochlor 1254	Chronic	2.0E-005	mg/kg-day	50%	1.0E-005	Eyes	300	IRIS	11/01/1996
Arsenic	Chronic	3.0E-004	mg/kg-day	95%	2.9E-004	Skin	3	IRIS	02/01/1993
Barium	Chronic	7.0E-002	mg/kg-day	7%	4.9E-003	Kidney	3	IRIS	03/30/1998
Beryllium	Chronic	2.0E-003	mg/kg-day	1%	2.0E-005	Small Intestines	300	IRIS	04/03/1998
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-002	mg/kg-day	55%	1.1E-002	Liver	1000	IRIS	05/01/1991
Cadmium	Chronic	5.0E-004	mg/kg-day	5%	2.5E-005	Kidney	10	IRIS	02/01/1994
Chromium (VI)	Chronic	3.0E-003	mg/kg-day	2%	6.0E-005	Skin	300	IRIS	02/01/1996
Copper	Chronic	1.0E+000	mg/kg-day	20%	2.0E-001	GI Tract	20	HEAST	07/01/1997
Di-n-Butyl phthalate	Chronic	1.0E-001	mg/kg-day	50%	5.0E-002	Skin	1000	IRIS	08/01/1990
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	1.4E-001	mg/kg-day	5%	7.0E-003	CNS	1	IRIS	05/01/1996
Mercury (elemental)	Chronic	3.0E-004	mg/kg-day	20%	6.0E-005	Nervous System	30	HEAST	05/01/1995
Methyl ethyl ketone	Chronic	6.0E-001	mg/kg-day	80%	4.8E-001	Fetus	3000	IRIS	05/01/1993
Methylene Chloride	Chronic	6.0E-002	mg/kg-day	80%	4.8E-002	Liver	100	IRIS	03/01/1988
Methyl isobutyl ketone	Chronic	8.0E-002	mg/kg-day	80%	6.4E-002	Liver, Kidney	3000	HEAST	07/01/1997
Nickel	Chronic	2.0E-002	mg/kg-day	27%	5.4E-003	Body Weight	300	IRIS	02/01/1996
Toluene	Chronic	2.0E-001	mg/kg-day	80%	1.6E-001	Liver, Kidney	1000	IRIS	04/01/1994
Trichloroethene	Chronic	6.0E-003	mg/kg-day	100%	6.0E-003	NA	--	NCEA	04/13/2000
Vanadium	Chronic	7.0E-003	mg/kg-day	20%	1.4E-003	NA	100	HEAST	07/01/1997
Vinyl Chloride	Chronic	3.0E-003	mg/kg-day	100%	3.0E-003	Liver	30	IRIS	08/07/2000
Zinc	Chronic	3.0E-001	mg/kg-day	20%	6.0E-002	Blood	3	IRIS	10/01/1992
1,1,2-Trichloroethane	Chronic	4.0E-003	mg/kg-day	81%	3.2E-003	Blood	1000	IRIS	02/01/1995
1,1-Dichloroethene	Chronic	9.0E-003	mg/kg-day	80%	7.2E-003	Liver	1000	IRIS	04/01/1989
1,2-Dichloroethane	Chronic	3.0E-002	mg/kg-day	100%	3.0E-002	NA	1000	NCEA	04/13/2000

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD, where:

CDI = Chronic Daily Intake
RfD = reference dose; and
CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

Appendix A provides hazard quotients (HQs) for each assessed route of exposure and the hazard index (or HI, i.e., sum of hazard quotients) for all routes of exposure relative to human health risks for certain potentially affected Site workers and visitors, and a summary of this risk information is given in Table H-1. The Risk Assessment Guidance for Superfund (RAGS) states that, generally, a hazard index (HI) greater than 1.0 indicates the potential for adverse non-cancer effects. Table G-3 gives a summary of Site calculated human health risks by receptor group, contaminants, and Site area. However, it may also be useful to compare data for a specific media, using the data in Appendix A. For example, the HI for an Adult and Child Resident's exposure to shallow groundwater is 200 and 400, respectively. The HI for an Adult and Child Resident's exposure to deep groundwater is 5 and 10, respectively.

Table G - 3
Summary of Calculated Human Health Risks

Receptors	Hazard Index	Carcinogenic Risk	Primary Source - Pathways	Primary Constituents
Current Land Use				
Adult Site Visitor/ Trespasser	3	3 E - 05	Surface Soil - dust inhalation, surface soil ingestion, dermal contact with surface and subsurface soils	1,1,2 - trichloroethane antimony
Future Land Use				
Future Worker	70	1 E - 02*	Surface soil, Subsurface soil, Groundwater - ingestion of surface soil, dermal contact with surface and subsurface soil, groundwater ingestion	tetrachloroethene 1,1,2 - trichloroethane vinyl chloride antimony
Future Adult Resident	200	3 E - 02*	Surface soil, Subsurface soil, Groundwater - dust inhalation, ingestion of surface soil, dermal contact with surface and subsurface soil, ingestion of groundwater, inhalation of VOCs during showering	tetrachloroethene 1,1,2 - trichloroethane polychlorinated biphenyls antimony chromium methylene chloride
Future Child Resident	700	2 E - 02	Surface soil, Subsurface soil, Groundwater - dust inhalation, ingestion of surface soil, dermal contact with surface and subsurface soil, ingestion of groundwater, inhalation of VOCs during showering	polychlorinated biphenyls tetrachloroethene trichloroethene 1,1,2- trichloroethane 1,2 - dichloroethane methylene chloride antimony chromium

G.2 Summary of Ecological Risk Assessment

Methods to quantify ecological risk to aquatic and terrestrial ecosystems are continually being developed. At the time of the BRA, related benchmark data was limited or unavailable. In 1997, EPA issued the document "Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments, Interim Final", which outlines an up to eight-step process for conducting an ecological risk assessment, with various decision points along the way to determine if further study is necessary. This BRA, conducted in 1994, went through what is step 3 of the process in the current guidance, the refinement of COPCs.

G.2.1 Identification of Chemicals of Potential Concern

The purpose of this section was to determine whether or not any contaminants detected at the Site are above levels known to cause adverse effects in animals. Unlike human health evaluations, the emphasis of an ecological risk characterization is on populations, communities, and ecosystem, except for endangered or threatened species.

Potential threats to aquatic organisms of exposure to contaminated sediments were assessed by comparing sediment concentrations to sediment screening values obtained from USEPA Region 4. There were no concentrations of contaminants in sediments exceeding these values thus indicating no potential adverse affects to aquatic organisms (Table G-4A). VOCs were measured in the sediment but were not evaluated because sediment screening values do not currently exist for these compounds.

Table G-4A
Concentrations of Chemicals of Potential Concern in Sediment, and Screening Values

Contaminant	Maximum Sediment Concentration (mg/kg)	ER-L[1,2] (mg/kg)	ER-M[1,3] (mg/kg)
Barium	4.7	---	---
Chromium	2.6	80	145
Copper	2.28	70	390
Lead	2.42	35	110
Manganese	49.8	---	---
Nickel	0.92	30	50
Tetrachloroethene	0.007	---	---
Trichloroethene	0.002	---	---
Vanadium	3.87	---	---
Zinc	9.44	120	270

[1] NOAA Sediment Screening Values, 1990
[2] ER-L Effects Range Low
[3] ER-M Effects Range Medium
--- Sediment Screening Value not available

Only limited information was available on the potential threats of the surface soils located on this Site. These surface soils can impact vegetation that come in contact with contaminated surface soils. However, risks are not quantitatively addressed for vegetation despite evidence that vegetation may be directly exposed to contaminated surface soils. This is because the extent of exposure is unknown and sufficient data regarding intake, accumulation and effects of specific COPCs are not available. However, during the visual field reconnaissance, the following areas were discovered to contain stressed vegetation: a 30-by-30 foot area west of the process pad, a 30-by 30 foot area in the southwestern portion of the former landfill, a 25- by 25-foot area west of the process pad, the truck turnaround area, and the area adjacent to the railroad tracks. Although there was only limited information available concerning terrestrial risks, the potential for adverse effects was evident at the locations of stressed vegetation. Elevated levels of surface soil contaminants were detected in several areas where stressed vegetation was observed. Soil screening values were not available at the time the BRA was conducted. Soil contaminant concentrations can be found in Table G-1.

Surface water was evaluated utilizing Ambient Water Quality Criteria (AWQC) provided by EPA in the document Region IV Freshwater Water Quality Screening Values for Hazardous Waste Sites (EPA 1992e). South Carolina has adopted the AWQC as the State's surface water quality standards. The only compound to exceed these standards (the chronic screening values) was bis(2-ethylhexyl)phthalate; therefore, this contaminant is potentially a long-term threat to biota at the LCC Site. The acute screening values, presented in Table G-4B, were not exceeded by any surface water contaminant.

Table G-4B
Concentrations of Chemicals of Potential Concern in Surface Water, and Screening Values

Contaminant	Maximum Surface Water Concentration (μg/l)	Acute Screening Value[1] (μg/l)	Chronic Screening Value[1] (μg/l)
Acetone	12	---	---
bis (2-ethylhexyl)phthalate	29	1110	<0.3
1,2-dichloroethene	2	---	---
Manganese	31.3	---	---
Methyl isobutyl ketone	10	---	---
Tetrachloroethene	7	528	84
Toluene	2	1750	175
Trichloroethene	3	---	---
Zinc	13.2	65.04	58.91

1. EPA Region 4 Freshwater Water Quality Screening Values (EPA 1992e)
--- Screening Value not available

The location and areal extent of the groundwater plume containing VOCs indicate a potential for groundwater contaminants to discharge into Ferry Branch Creek. Low concentrations of VOCs were found in the downstream sediment sample. Therefore, groundwater was also evaluated using AWQC. Although some dilution would be expected upon discharge of groundwater to Ferry Branch Creek, the groundwater contaminant concentrations were compared to the surface water quality standards (chronic screening values and acute screening values) as a worst case indication of potential adverse effects on the aquatic biota (Table G-4C).

Table G-4C
Concentrations of Chemicals of Potential Concern in Groundwater and Screening Values

Contaminant	Maximum Groundwater Concentration (µg/l)	Acute Screening Value[1] (µg/l)	Chronic Screening Value[1] (µg/l)
acetone	27,000	---	---
benzoic acid	52	---	---
chlorobenzene	36	1,950	195
1,2-dichlorobenzene	17	---	---
1,2-dichloroethane	810	11,800	2,000
1,1,-dichloroethene	710	---	---
1,2-dichloroethene	5	13,500	1,350
2,4-dimethylphthalate	17	3,300	330
isophorone	21	11,700	1,170
methyl ethyl ketone	140,000	---	---
methyl isobutyl ketone	13,000	---	---
methylene chloride	12,000	19,300	1,930
naphthalene	29	---	---
tetrachloroethene	11,000	528	84
toluene	18,000	1,750	175
1,1,1,-trichloroethane	1,300	5,280	528
1,1,2-trichloroethane	9,800	3,600	940
trichloroethene	2,400	---	---
vinyl chloride	2,700	---	---
aluminum	27,200	---	---
arsenic	13.2	360	190
barium	525	---	---
cadmium	5.99	1.79	0.66
cobalt	41.2	---	---
manganese	8,920	---	---
mercury	0.14	2.40	0.012
zinc	155	65.04	58.91

1. EPA Region 4 Freshwater Water Quality Screening Values (EPA 1992e).
--- Screening Value not available.

The compounds that exceeded chronic screening values were methylene chloride, tetrachloroethene, toluene, 1,1,1,-trichloroethane, 1,1,2-trichlorethane, cadmium, mercury and zinc. The compounds that exceeded acute screening values were tetrachloroethene, toluene, 1,1,2-trichloroethane, cadmium and zinc.

G.2.2 Ecological Exposure Assessment

The objective of the exposure assessment was to identify the pathways by which the ecological communities of the Site may come in contact with the chemicals of potential concern. As with a human exposure, a complete exposure pathway consists of four essential elements:

A source and mechanism of chemical release;
A retention or transport media for the released chemical (e.g., air or groundwater);
A point of ecological contact with the contaminated medium (exposure point); and
An exposure route (e.g., inhalation or ingestion) at the exposure point

The natural community indigenous to the Site and surrounding areas has been greatly altered. Residential and commercial development has impacted the naturally occurring populations and species diversity by reducing the size and area of naturally occurring habitat. No critical habitats have been designated on the Site. The nearest wetland is a surface impoundment which is located approximately 1 mile southeast of the Site. However, this impoundment does not lie on the Ferry Branch Creek pathway, and the potential for adverse effects are minimal. Although there are numerous threatened or endangered plants and animals indigenous to South Carolina that could potentially be affected by this Site, no endangered or threatened species have been identified on this Site.

G.2.2.1 *Chemical Source and Release and Transport Mechanism*

Organic and inorganic contaminants have been detected at the Site. These sources of contamination could release chemicals to the surface and subsurface soils where they would either be retained in the onsite soils, degrade into other compounds, or be transported through the soils or groundwater. Contaminated soils from the Site surface may also be transported into surface water drainages, or by overland erosion.

G.2.2.2 *Potential Exposure Points*

The flora and fauna of the Site may come in contact with contaminants in the surface and subsurface soil through the following exposure routes:

Uptake by vegetative root systems;
Incidental ingestion during feeding, digging, or preening;
Direct dermal contact by burrowing animals;
Ingestion of contaminated soils by invertebrates;
Inhalation of fugitive dust;
Dermal exposure from contaminated soil particles adhering to skin, fur, or feathers
Ingestion of animals or plants on which contaminated soils adhere; and
Ingestion of contaminated prey.

Surface water in the ditch that flows to Ferry Branch Creek and areas of standing water may become contaminated by the transport of contaminated soils from Site surface water runoff. The amount of exposure would vary depending on the hydrology of the surface waters. Organisms in closed or restricted systems, such as low-lying areas of the ditch, would likely be exposed to contamination on a nearly continuous basis. On the other hand, contaminants reaching the Catawba River might be diluted by the great volume of water flowing in the river, thus decreasing the potential for adverse effects on the biota. Wildlife may be exposed to contaminated surface water in the following ways:

- Terrestrial and aquatic wildlife may be exposed through direct ingestion or ingestion of contaminated prey.
- Amphibians and invertebrates that spend all or part of their life cycle inhabiting these surface waters may be exposed through dermal contact and uptake by gills.
- Terrestrial animals may be exposed through dermal exposure and absorption while washing, wading, swimming or feeding in contaminated water.
- Aquatic and terrestrial animals may be exposed through ingestion of constituents in solution or suspension.
- Terrestrial animals may be exposed through ingestion of constituents retained on the skin, fur or feathers during preening.
- Fish may be exposed through dermal contact and uptake by gills.

At the time the BRA was conducted, Ferry Branch Creek was qualitatively determined to be a groundwater discharge area along its course on the eastern boundary of the Site. Although some dilution would be expected as groundwater discharges to the creek, aquatic organisms that inhabit the creek may come into contact with the potential chemicals of concern. Exposure routes would be the same as those listed for surface water.

No toxicity tests or field studies were conducted.

G.2.3 Ecological Risk Characterization

No chemicals were identified in the Ecological Risk portion of the 1994 Baseline Risk Assessment which posed risk to ecological receptors. Confirmatory samples will be re-screened with the new US EPA Region 4 screening values during the Remedial Design and Remedial Action.

G.3 Basis for Action and Summary.

Actual or threatened releases of hazardous substances from the Site, if not addressed by implementing the response action selected in this Record of Decision, may present a continuing imminent and substantial endangerment to public health, welfare, or the environment. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Table G - 5 : Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Y or N)	Receptor	Endangered or Threatened Species Flag (Y or N)	Exposure Routes
Surface Water	N	-Terrestrial Animals - Aquatic Animals	Y Y	- Dermal contact and uptake by gills - Direct ingestion or ingestion of contaminated prey - Ingestion of chemicals in solution or suspension - Ingestion of chemicals retained on the skin, fur or feathers during preening - Dermal exposure while washing, wading, swimming, or feeding in contaminated surface water. - Direct ingestion or ingestion of contaminated prey - Ingestion of chemicals in solution or suspension.
Groundwater	N	- Same as surface water	N	-Potential groundwater discharge to surface water, same exposure routes as surface water.

Table G - 5: Ecological Exposure Pathways of Concern				
Exposure Medium	**Sensitive Environment Flag (Y or N)**	**Receptor**	**Endangered or Threatened Species Flag (Y or N)**	**Exposure Routes**
Soil	N	-Terrestrial animals -Terrestrial plants	N	- Ingestion and direct contact w/ chemicals in soils - Uptake of chemicals via root systems.
Sediments	N	- Benthic organisms -Terrestrial plants	N	- Ingestion and direct contact w/ chemicals in wetland soils - Uptake of chemicals via root systems

H. REMEDIAL ACTION OBJECTIVES

This section presents a summary of the issues and areas of concern that have been identified at the Site, the remedial objectives for the Site, and the general response actions that were selected for evaluation in the FS.

H.1 Description of RAOs

Based on the potential exposure pathways that have been identified at the Site, the general Remedial Action Objectives (RAOs) for the Site are as follows:

- Eliminate threats associated with direct contact and ingestion of surface soil;
- Prevent ingestion and inhalation of contaminated groundwater;
- Reduce or eliminate further contamination of groundwater;
- Prevent groundwater contamination from migrating beyond Site boundaries, specifically to Ferry Branch; and,
- Restore the groundwater quality underlying the Site such that it meets applicable or relevant and appropriate drinking-water standards.

H.2 Rationale for RAOs and How RAOs Address Risks

The RI identified the distribution and concentrations of contaminants at the Site. The BRA evaluated these data to develop a current, site-specific estimate of human health risks and ecological risks at the Site. The Site risks resulting from the BRA calculations may be compared to USEPA's risk management guidance range of 1E-04 to 1E-06[2] for incremental human carcinogenic risk, or a Hazard Index greater than 1.0 for non-carcinogenic risk , as the

[2] 1E-04 is equivalent to 1 in 10,000. 1E-06 is equivalent to 1 in 1,000,000. USEPA's risk management guidance range is based on ensuring that a site results in a risk of fewer than 1 additional person in 10,000 developing cancer, or fewer than 1 additional person in 1,000,000 developing cancer. Generally EPA uses the more conservative figure of 1 in 1,000,000 for residential scenarios.

point of reference for remediation.

The BRA considered the calculated risks under both current and future land use scenarios. Under current land use, risks were calculated for an Adult Site Visitor or Trespasser. In developing the risk assessment for future exposures, the BRA considered that the future use of the Site may be industrial or residential. Based on surrounding land use, considering the proximity of the railroad tracks and Bowater Paper Mill, it is possible the Site will remain industrial. However, given the rural nature of the Site location, the fact that there are residences in the vicinity, and the current zoning as a rural development district, it is reasonable to assume that the Site could be developed for residential use in the future. Therefore the BRA assessed health effects of Site contaminants on a Future Worker, Future Adult Resident, and Future Child Resident.

A summary of these risks was shown in Table G - 3. The Hazard Index (HI) for non-carcinogenic risks is greater than or equal to 1.0 for all future residential land use scenarios considered during the BRA. The 1E-06 incremental human carcinogenic risk threshold is expected to be exceeded for all residential land use scenarios as well. The 1E-04 incremental human carcinogenic risk threshold is expected to be exceeded for all residential land use scenarios.

The goal of the proposed alternatives is to reduce the excess cancer risk associated with exposure to contamination to one in one million, and to reduce the non-carcinogenic hazard index to a level of less than 1.

In order to accomplish this, remediation goals (RGs) for surface soil, subsurface soil, and groundwater were developed. These are summarized in Table H -1 . RGs for surface soil were calculated based on reduction of residential risk from exposure to surface soil. Remediation goals for groundwater were set at the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act for all but three (3) constituents, for which no MCL has been set. The RGs for these constituents, methyl isobutyl ketone, methyl ethyl ketone, and acetone, were calculated in the BRA. Due to the potential for migration from subsurface soil to groundwater, RGs for subsurface soil were calculated for all constituents at levels satisfactory to achieve the RGs for groundwater.

Because the risk assessment was conducted in 1994 based upon information available at that time, EPA may re-evaluate the RGs during the Remedial Design phase to ensure that all calculated RGs are adequate based on current information. Site-specific leach tests were conducted by the PRP's in order to calculate site-specific soil RGs, and will be submitted as an addendum to the FS. EPA will evaluate the methodology and results of these tests to determine if changes to the soil RGs are necessary. The RGs for COCs in groundwater which are set at the MCL would be re-evaluated only if the MCLs for the COCs are set at more protective levels under the Safe Drinking Water Act. Any change in the RGs would be documented by EPA in a ROD Amendment or Explanation of Significant Differences.

Soils and groundwater will be re-sampled during the Remedial Design stage to confirm the current concentrations of COCs at the site.

Table H - 1 : Remediation Goals			
Contaminant of Concern	**Surface Soil (mg/Kg)**	**Subsurface Soil (mg/Kg)**	**Groundwater (ug/Kg)**
bis (2-ethylhexyl) phthalate	44	---	---
Antimony	31	---	---
Arsenic	23	---	---
Cadmium	68	---	---
Copper	2,540	---	---
Lead	400	---	---
Total PCBs (Arochlor)	1	---	---
Tetrachloroethene (PCE)	19	30	5
Trichloroethene (TCE)	63	16	5
1,1,2-Trichloroethane	12	11	5
Toluene	484	3,300	1,000
Methylene Chloride	93	10	5
Methyl Ethyl Ketone	2,940	1,989	690
1,2-dichloroethane	---	10	5
1,2-dichloroethene	---	285	70
Acetone	---	3,955	1,560
Methyl Isobutyl Ketone	---	2,028	280
Vinyl Chloride	---	---	2

Notes:
1 - Surface soil remediation goals (RGs) calculated in BRA based on reduction of risk from exposure to surface soil.
2- Subsurface soil RGs were calculated in the BRA for all COCs at levels satisfactory to achieve the RGs for groundwater.
3 - Groundwater RGs were set at the Maximum Contaminant Levels under the Safe Drinking Water Act for all but three contaminants, methyl isobutyl ketone, methyl ethyl ketone, and acetone, which do not have MCLs. RGs were calculated for these COCs in the BRA.

I. DESCRIPTION OF ALTERNATIVES

I.1 Description of Remedy Components

The objective of this section is to provide a brief explanation of the remedial alternatives developed for the Site. The Feasibility Study presented various technology alternatives for addressing contamination within the surface soil, subsurface soil, and groundwater at the Site. Using various combinations of the technologies which had some feasibility for this Site, nine (9) alternatives were developed. A brief summary of each alternative is presented below.

No-Action Alternative
- No further action under CERCLA would be conducted.

Alternative 1 -
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- Monitored Natural Attenuation of Shallow Groundwater Zone; and
- Monitored Natural Attenuation of Deep Groundwater Zone.

Alternative 2 -
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- In-situ Sparging (or In-well Stripping) of Shallow Groundwater Zone in Source Area;
- Monitored Natural Attenuation of Shallow Groundwater Zone Outside the Source Area; and
- Monitored Natural Attenuation of Deep Groundwater Zone.

Alternative 3 -
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- In-situ Sparging (or In-well Stripping) of Shallow Groundwater Zone in Source Area;
- Monitored Natural Attenuation of Shallow Groundwater Zone Outside the Source Area;
- In-situ Sparging for Deep Groundwater Zone Impacts in the Southeast Corner of the Site; and
- Monitored Natural Attenuation of Deep Groundwater Zone Downgradient of the Deep Sparging Location.

Alternative 4 -
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- In-situ Sparging (or In-well Stripping) of Shallow Groundwater Zone in Source Area;
- Monitored Natural Attenuation of Shallow Groundwater Zone Outside the Source Area;
- In-situ Hydrogen Release Compound (HRC) Fence in Deep Groundwater Zone; and
- Monitored Natural Attenuation of Deep Groundwater Zone Downgradient of the HRC Fence Location.

Alternative 5 -
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- Groundwater Pump and Treat via Air Stripping and Granular Activated Carbon (GAC) of Shallow Groundwater Zone in Source Area;
- Monitored Natural Attenuation of Shallow Groundwater Zone Outside the Source Area; and
- Monitored Natural Attenuation of Deep Groundwater Zone.

Alternative 6 -
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- Groundwater Pump and Treat for Shallow Groundwater Zone Impacts; and
- Groundwater Pump and Treat for Deep Groundwater Zone Impacts

Alternative 7 -
- Institutional Controls;
- Excavation and Off-site Disposal of All Impacted Soils;
- In-situ Sparging (or In-well Stripping) of Shallow Groundwater Zone in Source Area;
- Monitored Natural Attenuation of Shallow Groundwater Zone Outside the Source Area; and
- Monitored Natural Attenuation of Deep Groundwater Zone Impacts.

Alternative 8 -
- Institutional Controls;
- Excavation and On-Site Thermal Desorption for Organic Compound Soil Impacts;
- In-situ Sparging (or In-well Stripping) of Shallow Groundwater Zone in Source Area;
- Monitored Natural Attenuation of Shallow Groundwater Zone Outside the Source Area; and
- Monitored Natural Attenuation of Deep Groundwater Zone Impacts.

Alternative 9-
- Institutional Controls;
- Excavation and Off-site Disposal of Surface Soils;
- In-situ Source Area Vacuum Extraction of Subsurface Soils;
- Expansive Pump and Treat via Air Stripping and GAC Post-Treatment of All Shallow Groundwater Zone Impacts; and
- Expansive Pump and Treat via Air Stripping and GAC Post-Treatment of All Deep Groundwater Zone Impacts in the Bedrock Trough and Southeast Corner of the Site.

I.2 Common Elements and Distinguishing Features of Each Alternative

The goal of the Institutional and Physical Controls (ICs) is to supplement the active remedial measures being implemented by preventing exposure to contaminants in the surface and subsurface soils and preventing consumption of groundwater beneath the Site during the period of active treatment. A variety of ICs were outlined in the FS, and were intended to be used in conjunction with all of the alternative remedies presented. The actual instruments used as ICs (e.g., easements and covenants, local zoning, title notices and land use restrictions through order from or agreements with the property owner) will be negotiated prior to the Remedial Design.

To address impacted surface soils, up to 18 inches bgs, all alternatives except #8 use excavation and off-site disposal. Although the actual amount of soil to be removed would be determined through additional sampling in the Remedial Design phase, the estimated volume of surface soil to be excavated is 310 cubic yards, or 470 tons.

Alternative #7 considers the excavation and disposal of all impacted subsurface soils, in addition to the surface soils. Alternative #8 considers the excavation and on-site thermal desorption of soils impacted with organic compounds. The high cost of on-site thermal treatment resulted in a present worth cost for this alternative which was higher than the median cost of the alternatives considered, even though the groundwater remedy proposed (natural attenuation) is less costly than other groundwater alternatives considered. Alternatives #1 through #6 and Alternative #9 consider in-situ source area vacuum extraction of subsurface soils, which is estimated to require 8 years to attain the Preliminary Remediation Goals.

The primary ARAR affecting soil excavation and disposal are the RCRA land ban restrictions and the CERCLA off-site policy.

Vacuum extraction would require compliance with 40 C.F.R. Parts 60 and 61, promulgated under the authority of the Clean Air Act. Ambient air quality standards and standards for emissions to the atmosphere fall under these regulations. Included are the National Emissions Standards for Hazardous Air Pollutants (NESHAPs), which apply if the extraction process is a major source of hazardous air pollutants (emitting greater than 10 tons per year of any of the listed toxic air pollutants, or 25 tons per year of a mixture of air toxics).

The remedial goals (RGs) for groundwater, as outlined in Table H-1, are based on the ARAR affecting the groundwater remediation, the MCLs established under the Safe Drinking Water Act at 40 C.F.R. Parts 141-143.

Groundwater remediation options vary among the 9 alternatives between options for the shallow and deep zones of the aquifer, and options which address contamination within and outside of the source areas. Alternative 1 is the only alternative which calls for using only monitored natural attenuation for all shallow and deep groundwater impacts, but Alternatives 2 through 8 use monitored natural attenuation to address the shallow groundwater zone OUTSIDE the source area. Although monitoring data indicate that some natural attenuation of the VOCs is occurring in the groundwater, insufficient data is available to conclude that monitored natural attenuation alone would be sufficient to achieve the RGs for those compounds. The actual period which would be necessary for attainment of remedial objectives is not known, but for the purpose of cost comparison, monitoring of the shallow and deep groundwater zones for was assumed to be quarterly for ten (10) years and semi-annually for an additional forty (40) years.

Alternatives #5, #6, and #9 each recommend groundwater pump and treatment for one or both groundwater zones.. Pump and treatment of groundwater tends to be relatively expensive, making these three options more costly than several of the other proposed alternatives. In addition, treatment would be expected for up to 30 years and may still not meet the RGs.

Alternatives #2, #3, #4, #7, and #8 each recommend in-situ sparging or in-well stripping for addressing impacts within the shallow or deep groundwater zone, or both. An advantage to using in-situ sparging occurs in alternatives #2, #3, and #4, which also propose the use of in-situ vacuum extraction to address subsurface soil contamination. As air or nitrogen are introduced into the sparge wells, volatilized contaminants would rise into the vadose zone and be captured by the soil vapor extraction system, making these technologies complementary.

I.3 Expected Outcomes of Each Alternative

The objective of the Superfund remedial response as described in this Final Record of Decision is the reduction of human health risks and ecological risks in those areas where significant risks exist at this Site. The expected outcome of the preferred alternative must be demonstrated to address these specific significant risks.

- The No Action alternative would worsen the Site's condition in the short-term because surface soils would continue to contaminate groundwater, and the groundwater contamination may continue to migrate, eventually impacting Ferry Creek and continuing downstream. The No Action alternative fails to address any of the human health risks identified in the risk assessment, and is not considered further in this document.

- Alternative # 1 addresses the surface soil contamination, as well as the subsurface soil contamination, and would therefore prevent the contamination from continuing to degrade groundwater quality. All current groundwater impacts would be allowed to naturally attenuate. The extent to which this would occur, the area over which the contamination may continue to migrate, and the time necessary for this to happen, are unknown. Long-term risk from residential drinking water would remain.

- Alternative # 2 offers about the same outcome as Alternative # 1, except some groundwater remediation within the shallow source area would be addressed. Long-term risk from residential drinking water would remain.

- Alternative # 3 continues to build on the remedies offered in Alternatives #1 and #2 by also addressing contamination of deep groundwater impacts in the southeast corner of the site through treatment by in-situ sparging. The remaining deep groundwater impacts would be allowed to naturally attenuate. This option reduces long and short-term human health risks at the site.

- Alternative # 4 is very similar to Alternative #3, in that it builds upon the earlier alternatives. However, the treatment addressing deep groundwater impacts in this alternative is an in-situ hydrogen release compound (HRC) fence in the deep groundwater, which would treat deep groundwater impacts and prevent further off-site migration of the contamination. Any impacts down-gradient of the HRC fence would be allowed to naturally attenuate. Long and short-term human health risks would be address by this option.

- Alternative #5 addresses surface and subsurface soils in the same manner as Alternatives 1 through 4, through the excavation and off-site disposal of surface soils, and the in-situ source area vacuum extraction of subsurface soils. However, in this alternative, groundwater pumping and subsequent treatment using air stripping and granular activated carbon (GAC) would be used to address the contamination in the source area of the shallow groundwater zone. All other groundwater impacts would rely upon natural attenuation. This alternative would not address long-term human health risk posed by residential drinking water.

- Alternative #6 differs from Alternative #5 in only one respect. Instead of relying on natural attenuation for all groundwater impacts outside of the shallow aquifer source area, groundwater pump and treatment would also be used to remediate the deep groundwater zone in the southeast corner of the site. This alternative would address long and short-term human health risk but the time frame to achieve the RGs is unknown.

- Alternative # 7 addresses all soil impacts through excavation and off-site disposal to a secure landfill. Groundwater treatment would occur only in the shallow aquifer source area through in-situ sparging or in-well stripping. Remaining groundwater impacts would be allowed to naturally attenuate. This alternative would not address long-term human health risk posed by residential drinking water.

- Alternative #8 is the only alternative which addresses the organic compounds of surface and subsurface soils through on-site thermal desorption. Soils with remaining inorganic contaminants may require additional treatment or stabilization prior to disposal at an off-site landfill. Groundwater treatment would be addressed as in Alternative 7, only in the shallow aquifer source area, with natural attenuation being allowed for other groundwater impacts.

- Alternative #9 recommends the excavation and off-site disposal of surface soils at a secure landfill. Subsurface soils would be addressed through in-situ source area vacuum extraction. Expansive pump and treat would be used to address groundwater contamination for all shallow groundwater impacts, and for deep groundwater impacts in the bedrock trough and the southeast corner of the Site. This alternative would address all risks at the Site, but there is some uncertainty in the ability of pump and treat to reach the RGs for groundwater in a reasonable or acceptable amount of time.

J. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The National Contingency Plan (NCP), set forth at 40 C.F.R. Part 300, requires analysis of remedial alternatives according to nine overall criteria. An initial evaluation is made according to <u>two (2) threshold evaluation criteria</u>: 1) overall protection of human health and the environment and 2) compliance with ARARs. Surviving alternatives must then be subjected to a comparative analysis of the alternatives based upon <u>five (5) primary balancing criteria</u>: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility, and volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. Finally, <u>two (2) modifying criteria</u> , 1) state/support agency acceptance; and 2) community acceptance, are used to determine the acceptable alternative(s).

In the Feasibility Study, numerous technologies for remediation of soil and groundwater were developed and then screened based upon the general categories of effectiveness, implementability, and cost. Remaining technologies were then grouped into nine site alternatives which were analyzed and compared according to the nine NCP criteria.

J.1 <u>Threshold Criteria</u>

J.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the alternatives, except the no-action alternative, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the Site through excavation of contaminated surface soils, excavation or treatment of subsurface soils, engineering controls, and institutional controls. All alternatives remove subsurface soil impacts to groundwater through either treatment or excavation and disposal. With the exception of Alternative #1, all alternatives address shallow groundwater impacts through extraction and/or treatment in the source area. Alternative #1 would use monitored natural attenuation to address shallow groundwater impacts. For deeper groundwater impacts, Alternatives #1, #2, #5, and #8 rely on monitored natural attenuation to reduce contaminant concentrations to acceptable levels. With no active remedy to address shallow or deeper groundwater impacts, Alternative #1 would not reach the remedial goals in a reasonable time, and may allow groundwater contamination to progress off-site. Alternatives #3 and #4 control migration of the contaminant plume in the deeper groundwater and provide for treatment at the leading edge of the plume as natural attenuation processes occur upgradient. Alternatives #6 and #9 provide for more aggressive capture of the plume through the use of pump and treatment systems. However, the pump and treat remedies have the potential for drawing contaminants deeper into the aquifer in the vicinity of the recovery wells, and may draw constituents in the deeper zone closer to Ferry Branch.

J.1.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP § 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs", unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for a invoking a waiver.

All soil and groundwater alternatives, with the exception of the no action alternative, would meet their respective ARARs from Federal and State laws. Excavation and disposal of soils would primarily trigger the RCRA generator and land ban requirements. On-site treatment technologies considered, such as on-site thermal desorption and air stripping, would be required to meet Clean Air Act standards. The Safe Drinking Water Act governs the standards for groundwater cleanup. Historical data indicate the groundwater pump and treat remedies may have difficulty achieving MCLs within a 30 year time frame. However, monitored natural attenuation will require an even longer time period for achieving MCLs. At least 50 years for the monitored natural attenuation alternative to attain MCLs was considered reasonable in the evaluation of these alternatives.

J.2 Primary Balancing Criteria

J.2.1 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Each alternative, except the No-Action alternative, provides some degree of long-term protectiveness through removal and/or treatment of surface soil exposures and subsurface soil contaminant sources. All groundwater alternatives would be effective in the long-term by permanently reducing contaminant concentrations. Natural attenuation has some uncertainty associated with how it may be affected by other remediation methods such as vacuum extraction and the uncertain time required to reach the final clean-up levels. In addition, natural attenuation may allow groundwater over MCLs to migrate off-site prior to attaining the RGs, risking exposure. The alternatives providing for pump and treatment have some uncertainty with regard to their ability to attain the RGs, even when operated for long periods of time.

Reviews at least every five (5) years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain on-site in concentrations above health-based levels.

J.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

All of the alternatives, except for the No Action alternative, achieve reduction of toxicity, mobility, and volume of the chemicals of concern. Only Alternative # 8 relies on treatment to remove surface soil contaminants. However, the on-site thermal desorption which is a part of Alternative #8 would treat only the volatile organic compounds in the surface and subsurface soil. All alternatives, except Alternative #7, employ extraction and treatment to address the subsurface soil source. However, the subsurface soil component of Alternative #7 removes all contaminated subsurface soil for landfill disposal. Depending on the soil contaminants and their levels, treatment may be required prior to land disposal.

For shallow groundwater, only Alternative #1 does not provide for treatment. For the deeper groundwater, Alternatives #3 and #4 provide for treatment at the leading edge of the plume, relying on natural attenuation to reduce contaminant levels upgradient. Alternatives #6 and #9 employ treatment systems to address deeper groundwater contamination across the plume. No other alternative provides for treatment in the deeper groundwater, instead relying on natural attenuation to reduce contaminant concentrations. Monitored natural attenuation is also a component of all alternatives to reduce contaminants in groundwater to acceptable levels outside of the treatment areas.

J.2.3 Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup goals are achieved.

All alternatives provide short-term effectiveness for direct contact exposure through surface soil removal. For subsurface soils, Alternative #7 provides the highest degree of short-term effectiveness through excavation of all soils that may be a source of groundwater contamination. Alternative #8 is similarly effective through relatively short-term treatment of the soils to remove the contaminant source. Both of these alternatives present a higher short-term risk because of the potential for exposure of on-site workers to contaminated soils during excavation and materials handling activities. Additionally, Alternative #8 (on-site thermal desorption) presents a potential risk for short-term exposure to releases of contaminants or products of combustion as a result of the treatment technology. The other alternatives, which employ in-situ vacuum extraction to treat subsurface soil, also provide a high degree of short-term effectiveness, with a lower degree of risk for on-site workers.

For groundwater, the pump and treatment remedies in Alternatives #5, #6, and #9 have a high degree of short-term effectiveness due to the recovery of relatively high contaminant levels in the initial period of operations. The in-situ sparging remedies in Alternatives #2, #3, #4, #7, and #8 also provide a high degree of short-term effectiveness base on case studies indicating that PRGs may be attained in 4 to 8 years. The monitored natural attenuation remedies which serve as primary components of Alternative #1 for both shallow and deep aquifer impacts and Alternatives #2, #5, #7, and #8 for deep groundwater impacts provide a lower degree of short-term effectiveness due to the relatively long time necessary to achieve PRGs.

J.2.4 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All soil technologies and remedies are readily available and generally proven. All groundwater alternatives are equally implementable without construction difficulties. The pump and treatment systems are slightly more complex to operate and maintain than the in-situ systems. The pump and treat systems would also be required to meet NPDES standards for effluent discharge. All of the other alternatives have few associated administrative difficulties.

J.2.5 Cost

The estimated present worth costs, using a 5% discount rate, for the nine site-wide alternatives are:

Alternative #	Cost
1	$3,559,358
2	$4,296,441
3	$4,751,279
4	$5,782,613
5	$5,477,365
6	$6,147,265
7	$18,631,995
8	$9,661,215
9	$8,256,378

The estimated present worth costs for most of the alternatives (including thirty [30] years of O & M), not including the No Action alternative or Alternative #7, range from approximately $ 3,559,358 for Alternative 1 to approximately $ 9,661,215 for Alternative #8. The $18,631,995 cost of Alternative #7 is nearly twice the cost of Alternative #8 . This is because Alternative #7 recommends the excavation and off-site disposal of all impacted soils at the Site. Excavation and disposal costs are prohibitive when the volume of impacted subsurface soils is included. Alternatives #6 and #9 were above the median cost of the studied alternatives due to recommendation of groundwater pump and treat technology. The high cost of the pump and treat technology could not be justified when considering the long-term nature of this remedy, and the uncertainty in reaching the remedial goals. Detailed cost summaries can be found in the Feasibility Study.

J.3 Modifying Criteria

J.3.1 State/Support Agency Acceptance

The State has expressed its support for the Selected Remedy, presented in Section H of this ROD, through comments on the Proposed Plan, which can be found in the Administrative Record for the Site.

J.3.2 Community Acceptance

During the public comment period, the community did not specifically address any particular alternative. There was concern amongst the community about the safety of the groundwater and dissatisfaction with the pace of remedial action. Public acceptance of any of the alternatives allowing passive remediation of the groundwater (monitored natural attenuation) is unlikely.

K. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that the USEPA will use treatment to address principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). The 'principal threat' concept is applied to the characterization of 'source materials' at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only low risk in the event of exposure. According to *A Guide to Principal Threat and Low Level Threat Wastes (OSWER 9380.3-06FS, November 1991)*, wastes that generally do not constitute principal threats include, but are not limited to, the following: (1) non-mobile contaminated source material of low to moderate toxicity (surface soil containing chemicals of concern (COCs) that generally are relatively immobile in air or groundwater, i.e., non-liquid, low volatility, low leachability contaminants such as high molecular weight compounds) and (2) low toxicity source material (soil and subsurface soil concentrations not greatly above reference dose levels or that present an excess cancer risk near the acceptable risk range were exposure to occur).

The chief COCs being addressed by this Final ROD are volatile organic chemicals which are contaminating surface soils, subsurface soils, and groundwater. These VOCs in the soils continue to leach into the groundwater and are the principal threat at the Site.

L. THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives proposed in the feasibility study using the nine (9) criteria, and public comments, both USEPA and the State have determined that the most appropriate remedy for the Leonard Chemical Company Site, near Catawba, York County, South Carolina includes the following components:

- Institutional Controls
- Excavation and Off-site Disposal of Surface Soil
- In-situ Source Area Vacuum Extraction of Subsurface Soils
- In-situ Sparging for Shallow Groundwater Impacts
- Installation of a Treatment Barrier (In-situ Sparging or Injection of a Biodegradation Enhancement Compound) to Address Deep Groundwater Impacts
- Monitoring of Shallow and Deep Groundwater Zones

L.1 <u>Summary of the Rationale for the Selected Remedy</u>

The remedy selected is a combination of components used in the nine alternatives presented in the Feasibility Study, and most closely resembles Alternatives #3 and # 4. Normally, EPA selects a Remedy from among the alternatives given in the Feasibility Study. All technologies chosen for the Selected Remedy are evaluated in the Feasibility Study. However, in EPA's judgment, modifying Alternatives #3 and #4 to allow greater flexibility in the Remedial Design will result in the optimal remedy.

L.2 Description of the Selected Remedy

A general description of the Selected Remedy is presented in this section. The details of the design for the Selected Remedy, other than those stated below, will be set forth in the USEPA-approved Final Remedial Design during the Remedial Design and Remedial Action (RD/RA) phases of the Site response.

The Selected Remedy employs Institutional Controls to supplement the active remedial measures by preventing exposure to contaminants in the surface and subsurface soils, and preventing consumption of groundwater beneath the Site during the period of active treatment. Specifically, land and groundwater use restrictions (e.g., easements and covenants, local zoning, title notices and land use restrictions through order from or agreements with the property owner) will be implemented in order to provide for worker safety, limit soil disturbance, prevent use of the Site for residential purposes, prevent use of groundwater for potable purposes, and prevent any future uses of the Site that could compromise the effectiveness of the Selected Remedy.

The Selected Remedy employees excavation and off-site land disposal in remediation of the surface soils at the Site. Metal contamination at the Site occurs predominantly at the surface. Excavation can be performed with a backhoe, a small grader, a front-end loader, or a bulldozer. After excavation, impacted soils will be characterized for disposal at an off-site land disposal facility. RCRA Land Disposal Restrictions may apply which could necessitate treatment prior to disposal. Such treatment is typically done by the disposal facility. For example, the mobility of metal in the impacted soils may need to be reduced by stabilization before disposal. The estimated areas of surface soil excavation are presented in the Feasibility Study. For purposes of the FS, and the cost analysis of the Selected Remedy, surface soils were assumed to be from approximately 0" to 18" below ground surface. The precise area will be determined during the RD phase of the Site response, and depth will be determined by field screening during excavation.

The Selected Remedy employs in-situ vacuum extraction for remediation of the VOCs in the subsurface soils. In-situ treatment includes those processes that can be implemented and operated without requiring that the soils be moved. In-situ vacuum extraction relies on the physical properties of contaminants which volatilize under reduced pressure (i.e. - vacuum conditions). Also, the vacuum extraction process promotes greater airflow through the vadose zone soils, which enhances biodegradation of many VOCs and other organic compounds. The vacuum is introduced into the soils by a series of vertical or horizontal wells installed in the vadose zone. The wells are manifolded together and routed to a central blower system. The collection lines from the individual wells to the blower are typically constructed of PVC and routed below grade. The blower discharge may require treatment prior to discharge to the atmosphere, typically with activated carbon, and may require an air permit.

To address the impacts of VOCs in the shallow zone of the aquifer, in-situ sparging will be used as part of the Selected Remedy. In-situ sparging typically involves the injection of compressed air into sparge wells screened below the water table. As the air is released through the well screen and travels upward through the saturated zone, the VOCs present in the groundwater transfer into the vapor stream, reducing VOC concentrations in groundwater. The radius of influence for air sparging in Piedmont soils, such as those at the LCC Site, is typically 25 to 35 feet from the sparge point. A piping network is required to distribute compressed air to the sparge well points. This piping network is usually of PVC pipe, buried in trenches to protect the pipe from ultraviolet deterioration and from physical damage. The vapors generated from the system will be collected from the vacuum extraction system as the vapors rise to the vadose zone. The air sparging shallow zone layout is presented in the Feasibility Study. It is anticipated that this layout will require additional sparge wells in the vicinity of monitoring well four (MW-4). The exact number, locations, and depth of the sparge wells will be determined during the Remedial Design.

To address the impacts of VOCs in the deeper zone, one of two feasible technologies will be used as part of the Selected Remedy, either in-situ sparging or biodegradation enhancement. Either technology would be used in the southeast corner of the Site to treat contaminated groundwater in the deeper zone and prevent off-site migration of the contamination, and may also be applied for hotspot bedrock aquifer treatment. A treatability study or pilot-scale test by the PRP during the RD phase will be used to determine which technology will actually be applied. The number, locations, and depth of the sparge wells or biodegradation enhancement compound injection points will also be determined during the RD phase.

To increase the efficiency and effectiveness of biodegradation, carbon sources can be supplied to enhance or augment the on-going biodegradation processes. Such carbon sources may include molasses, sugars, or other proprietary compounds. These materials increase the activity of naturally occurring microbes or add microbes with specific compound-degrading properties. One example of a proprietary compound is Hydrogen Release Compound (HRC) is a proprietary food grade substance (a polylactate ester known as glycerol tripolylactate) which produces lactic acid and a low- level supply of hydrogen upon contact with water. Lactic acid occurs naturally in milk and foods. HRC enhances natural attenuation in two ways. First, HRC provides a substrate for microbes to assimilate other compounds such as oxygen to promote anaerobic conditions within the aquifer or to assimilate nitrate and sulfate which compete with chlorinated volatile organic compounds (VOCs) such as PCE in anaerobic biological reactions. Secondly, HRC provides a hydrogen source, or electron donor, which can be used by microbes which participate in reductive de-chlorination of chlorinated VOCs, or electron acceptors. The main advantage of HRC over other electron donors such as sugar and molasses, is that the hydrogen is released over a longer time period, requiring less frequent re-application.

Fence placement would be determined during the Remedial Design. Surface casing depths would vary depending on barrier placement. The injection points would be designed to provide an effective intercept configuration. If biodegradation enhancement is chosen during the RD, further analysis will be conducted to determine the material for injection. For purposes of the FS and the cost analysis in this ROD, HRC was used. In the case of HRC, re-injection is typically performed annually.

The Selected Remedy also includes monitoring of the groundwater wells across Ferry Branch from the Site during the Remedial Design and Remedial Action.

L.3 Summary of the Estimated Remedy Costs

The information in the following cost estimate summary table (Table L-1) is based on the best available information regarding the anticipated scope of the remedial alternative and uses a 7% discount rate. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

L.4 Expected Outcomes of the Selected Remedy

The purpose of this response action is to control risks posed by direct contact with soil and groundwater and to minimize migration of contaminants to groundwater. The results of the baseline risk assessment indicate that existing conditions at the Site may pose an excess lifetime cancer risk of 2E+02 from direct contact with contaminated soils and 5E+02 from ingestion of contaminated groundwater. This risk relates primarily to the metals in the soil and the VOCs in the soil and groundwater. Soil cleanup levels were determined through a site-specific risk analysis. These cleanup levels shall also be protective at the 1E-06 excess cancer risk level for each chemical of concern or to achieve a hazard quotient (HQ) of less than 1 for each chemical of concern. Groundwater cleanup levels were set at the MCL for each contaminant as required by the Safe Drinking Water Act. For those three contaminants for which no MCL has been set, site-specific protective levels were calculated during the risk assessment. Treatment shall be monitored to ensure cleanup levels are achieved. The Site is expected to be available for unrestricted residential land use as a result of the remedy. However, the time-frame for achieving unrestricted use is uncertain.

Table L-1
Selected Remedy Cost Summary[1]

Activity		Time Frame	Capital Costs	Annual O&M	O&M Present Value	Total Present Value[2]
Institutional controls		NA	$10,000	$1,000	$18,256	$28,256
Mobilization/demobilization & site clearing & prep		NA	$42,000	NA	NA	$42,000
In-situ source area vacuum extraction		8 years	$678,800	$138,040	$892,182	$1,570,982
Surface soil excavation & off-site disposal		10 years erosion control	$175,800	$5,000	$38,609	$214,409
Options for in-situ sparging for source area shallow aquifer impacts	Air Sparging	8 years	$622,004	$21,492	$128,329	$750,333
	Nitrogen Sparging	8 years	$637,004	$117,492	$ 701,545	$1,338,549
Options for in-situ treatment fence for deep aquifer impacts	Air Sparging	30 years	$223,465	$11,160	$138,462	$361,927
	Hydrogen Release Compound	30 years	$307,310	$62,200	$771,715	$1,079,025
Shallow/deep aquifer monitoring		Quarterly first 10 years	$0	$95,180	$579,456	$579,456
Shallow/deep aquifer monitoring		Semi-annual next 40 years	$0	$53,440	$336,725	$336,725
[1]- More detailed cost information is presented in Appendix B. [2] - Total Present Worth Cost = Capital Cost + Total O&M Present Worth Cost		**SUBTOTALS** using:			Shallow and Deep Aquifer Air Sparging Shallow Aquifer Air Sparging/Deep Aquifer HRC Shallow Aquifer Nitrogen Sparging/Deep Aquifer Air Sparging Shallow Aquifer Nitrogen Sparging/Deep Aquifer HRC	$3,908,842 $4,626,570 $4,497,688 $5,214,786
		TOTALS using: **(SUBTOTAL + 20% CONTINGENCY)**			Shallow and Deep Aquifer Air Sparging Shallow Aquifer Air Sparging/Deep Aquifer HRC Shallow Aquifer Nitrogen Sparging/Deep Aquifer Air Sparging Shallow Aquifer Nitrogen Sparging/Deep Aquifer HRC	$4,690,610 $5,551,884 $5,397,225 $6,257,743

M. STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP, the lead agency must select remedies that are (1) protective of human health and the environment, (2) comply with applicable or relevant and appropriate requirements (ARARs) (unless a statutory waiver is justified), are (3) cost-effective, and (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes (5) a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principle element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

M.1 Protection of Human Health and the Environment

The Selected Remedy, a modification of Alternatives 3 and 4, will adequately protect human health and the environment by means of removal, in-situ vacuum extraction, in-situ sparging, containment, groundwater monitoring, and institutional controls according to NCP §300.430(f)(5)(ii). The Selected Remedy will eliminate, reduce, or control existing and potential risks. The removal of soils to an off-site, secure, permitted, USEPA-approved hazardous waste disposal facility will significantly decrease potential long-term exposures. In-situ source area vacuum extraction of subsurface VOCs, and the construction of a treatment barrier fence will mitigate long-term risks associated with potential groundwater contamination exposures. The implementation of the Selected Remedy will not pose unacceptable or unreasonable short-term risks or significant cross-media impacts which may present a human health risk, and will reduce the potential exposures which are driving the primary human health risks at the Site.

M.2 Compliance with ARARs

The Selected Remedy, a modification of Alternatives 3 and 4, which generally consists of (1) excavation of surface soil contamination above the PRGs and removal to an off-Site, USEPA approved secure hazardous waste disposal facility; (2) in-situ vacuum extraction of VOC contamination from the subsurface; (3) construction of an air or nitrogen sparging system to remove VOCs from the shallow groundwater; and (4) construction of a groundwater barrier/treatment fence using air sparging or a biodegradation enhancement compound, complies with ARARs. The ARARs are presented below and in more detail in Table M-1.

Chemical, Location, and Action-Specific ARARs include the following:

The major chemical-specific ARAR for contaminants in drinking water is 40 C.F.R. Parts 141-143, which established the MCLs for constituents in drinking water under the Safe Drinking Water Act. This regulation sets MCLs for eight (8) of the eleven (11) constituents of concern in the groundwater remediation at the Site: tetrachloroethene (PCE), trichloroethene (TCE), 1,1,2-trichloroethane, toluene, methylene chloride, 1,2-Di-chloroethane, 1,2-Di-chloroethene, and vinyl chloride. The PRGs for the remaining constituents, methyl isobutyl ketone, methyl ethyl ketone, and acetone, were calculated in the BRA. MCLs are specifically identified in the National Contingency Plan as remedial action objectives for groundwater that is a current or potential source of drinking water (NCP 40 C.F.R. § 300.430(a)(1)(ii)(F).

There are no major location-specific ARAR's identified for this remedial action.

The major action-specific ARAR for this remedial action is 40 CFR Part 268, Land Disposal Restrictions. These regulations under the Resources Conservation and Recovery Act (RCRA) restrict the land disposal of certain wastes unless specified levels have been attained or specified treatment technologies have been applied. Soils containing metals may require stabilization prior to disposal, depending on the level of contamination of the excavated soil.

M.3 Other Criteria, Advisories, or Guidance To-Be-Considered (TBCs) for This Remedial Action

In implementing the Selected Remedy, USEPA may choose to follow criteria, advisories or guidance which would be non-binding. No TBCs were considered for this remedy.

M.4. Cost-Effectiveness

In the EPA's judgement, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: " A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (40 CFR 300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three (3) of the five (5) balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this represents a reasonable value for the money to be spent.

For this Site, Alternatives #7, #8, and #9 were the most costly alternatives presented, yet were not more effective at reducing long-range Site risk or more protective than Alternatives #3 and #4. Alternatives #2 through #5 were determined to be cost-effective, but Alternative #4 clearly offered greater protectiveness. The Selected Remedy, a modification of Alternative #4, provides the optimal protection and represents the better value for the money to be spent.

M.5 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable (MEP)

USEPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and which comply with ARARs, USEPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the five (5) balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-Site treatment and disposal, and considering State and community acceptance.

The Selected Remedy, a modification of Alternatives 3 and 4, treats, destroys, or contains the source materials constituting principal threats at the Site, achieving a significant risk reduction. The Selected Remedy satisfies the criteria for long-term effectiveness by removal of heavily contaminated soils to a USEPA-approved disposal facility for proper treatment followed by long-term containment. Institutional controls will be used to control land and groundwater uses during the period of active treatment at the Site. The Selected Remedy does not present short-term risks significantly different from the other treatment alternatives. Chief short-term risks reside with on-site workers involved in the actual Superfund remediation activities. There are no special implementability issues that set the Selected Remedy apart from any of the other alternatives evaluated.

M.6 Preference for Treatment as a Principal Element

The Selected Remedy addresses principal threats posed by the Site through the use of conventional environmental remediation technologies, such as excavation and off-site disposal of contaminated surface soils, in-situ treatment of subsurface soils by vapor extraction, and in-situ treatment of groundwater by air sparging and/or enhanced

Table M-1 Description of ARARs for Selected Remedy					
Authority[1]	**Medium[2]**	**Requirement**	**Status[3]**	**Synopsis of Requirement**	**Action to be Taken to Attain Requirement**
Federal Regulatory Requirement	Soil	Resources Conservation and Recovery Act (RCRA) - Subtitle C Generator Requirements	Applicable	Hazardous waste generators in SC are required to obtain a RCRA ID number from SCDHEC. A hazardous waste determination must be made on all solid waste prior to disposal. Waste characterized as hazardous must be disposed of in a Subtitle C regulated landfill.	A RCRA ID number has been obtained for the Site. Surface soils removed will be characterized as hazardous or non-hazardous and, where applicable, managed as a hazardous waste and disposed at a Subtitle C landfill.
Federal Regulatory Requirement	Soil	Resources Conservation and Recovery Act (RCRA) - Land Disposal Restrictions	Applicable	Hazardous waste may not be land disposed until certain treatment standards have been met. For soils, this would generally mean incineration at a permitted treatment facility if necessary to attain the LDR standard.	Any soils or other waste characterized as hazardous at the Site will be treated as necessary to achieve the land disposal restriction levels prior to disposal.
Federal Regulatory Requirement	Air	Clean Air Act (CAA)	Relevant and Appropriate	Generators of certain quantities of hazardous air pollutants (HAP) must meet best available technology standards to minimize HAP emissions.	Soil vapor extraction system emissions will be designed to minimize emissions in compliance with the CAA.
Federal Regulatory Requirement	Groundwater	Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels	Applicable	MCLs have been established for a number of common organic and inorganic contaminants. These levels regulate the concentrations of contaminants in public drinking water supplies and are considered applicable for groundwater zones potentially used for drinking water.	Groundwater monitoring will be conducted to ensure groundwater remedies are progressing to achieve MCLs. Contingent remedy plans may be utilized if progress is not shown.

Notes
1 South Carolina has adopted these regulations by reference.
2 e.g., soil, groundwater, air, or hazardous waste
3 e.g., applicable, relevant and appropriate, or to be considered (TBC)

biodegradation. On-site thermal treatment of more heavily contaminated soils was considered cost prohibitive, but excavated soils will be treated at an off-site treatment facility to meet any land disposal restriction requirements prior to disposal. Excavation of subsurface soils was cost prohibitive when compared to other standard in-situ treatment technologies. Addressing contamination in the subsurface soils was given a high priority because the primary source contamination lies within this zone, and will continue to contaminate the shallow zone of the aquifer until it is addressed Treatment of contamination in the shallow zone of the aquifer in the source area will be accomplished also, in order to reduce risk, minimize further contamination in the deeper zone and prevent off-site migration. Treatment of contamination in the deeper zone is focused in the southeast corner of the Site, in order to prevent off-site migration of groundwater contaminated at levels greater than the MCLs.

M.7 Five-Year Review Requirements

Section 121(c) of CERCLA, as amended, and the NCP provide the statutory and legal bases for conducting five-year reviews. If there are any hazardous substances, pollutants, or contaminants remaining at the Site above levels that would allow unlimited use and unrestricted exposure, USEPA shall conduct a review of such remedial action no less often than each five (5) years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In general, a five-year review covers all operable units at a Site. If a Site has multiple operable units (OU), the triggering event for a statutory review is the initiation of remedial action at the first OU at which substances will remain above levels that allow for unlimited use and unrestricted exposure after completion of the remedial action.

Statutory reviews are triggered by the initiation of the remedial action. USEPA will conduct a statutory review of any site at which a post-SARA remedy, upon attainment of cleanup levels, will not allow unlimited use and unrestricted exposure. Examples of sites whose remedy would include: landfills, natural attenuation, institutional controls, technical impracticability waivers, capping, would require a statutory review. For statutory reviews, initiation of remedial action is determined by the "actual RA on-site construction" date. Statutory reviews cannot be discontinued. In other words, if the remedy upon completion will not meet health-based standards, such as chemical-specific applicable or relevant and appropriate requirements (ARARs), five- year reviews cannot be discontinued.

Policy reviews are triggered by construction completion. USEPA will conduct a policy review of (1) sites where no hazardous substances will remain above levels that allow unlimited use and unrestricted exposure after completion of the remedial action, but the cleanup levels specified in the Record of Decision (ROD) will require five (5) or more years to attain (e.g., long-term remedial action sites); and (2) pre-SARA sites at which the remedy, upon attainment of the ROD cleanup levels, will not allow unlimited use and unrestricted exposure. Examples of sites whose remedy includes: pump and treat systems, bioremediation, soil vapor extraction, would require a policy review. USEPA may discontinue policy five-year reviews when no hazardous substances pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. Reviews should be discontinued only when a five-year review documents that the contaminants of concern are reported at levels that would allow unlimited use and unrestricted exposure based on the appropriate period of monitoring. This determination should reflect that ARARs promulgated or modified after ROD signature result in a determination that the remedy is protective.

Upon the determination that five-year review is no longer necessary, a cover letter from the Regional Administrator, or his delegatee, to USEPA Headquarters should accompany the five-year review, stating that the Region has decided to discontinue reviewing the Site. The five-year review report should document that contaminants of concern are below appropriate levels and that the remedy meets ARARs. All subsequent statutory and policy reviews are due five (5) years after the completion date of the previous review.

The successful completion of the final Selected Remedy at the LCC Site will allow unrestricted access to all areas of the Site after the Selected Remedy is implemented. Therefore, policy reviews will be conducted every five (5) years after the remedial action construction is complete.

N. DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes from the Proposed Plan occurred during development of this ROD.

PART 3: THE RESPONSIVENESS SUMMARY

The Responsiveness Summary is required by Superfund law and regulations to provide a summary of citizen comments and concerns about the Site, as raised during the Public Comment Period, and a description of the responses to those concerns (CERCLA §117 and NCP §§300.430(f)(3)(i)(F) and 300.430(f)(5)(iii)(B)). All comments summarized in this document have been considered in the development and implementation of the Final Action at the LCC Site.

The following issues and concerns were expressed at the Proposed Plan Public Meeting and during the public comment period by the local community and contractor for the PRP. This is a summary of the comments only. The actual transcript of the meeting, and letters received during the public comment period are a part of the Administrative Record for this Site.

Local Community Comments and USEPA Responses:

COMMENT #1: Several residents expressed concern about potential solvent contamination in their drinking water wells and asked that EPA test their wells.

RESPONSE: EPA has required extensive groundwater monitoring at the Site to determine not only contamination levels but also to determine the direction and path of groundwater flow. The direction of groundwater flow at the Site is primarily west to east, with some southerly movement as it approaches Ferry Branch Creek. Most of the residents expressing concern lived north or west of the LCC Site, and their wells could not be affected by groundwater at the Site, and would therefore not be tested.

COMMENT #2: As more homes are constructed and more wells are installed for drinking water in the area, drawdown from the drinking water wells could potentially affect the direction of groundwater flow.

RESPONSE: While the direction of groundwater flow can be affected by heavy groundwater withdrawal in the area immediately surrounding a well, the rate of use of surrounding residential drinking water wells is relatively small and will not have any impact on groundwater flow direction at the Site. Review of this point by EPA technical staff indicates that even if additional residential wells are installed near the Site, their distance from the Site would still be great enough not to have any impact.

COMMENT #3: The Selected Remedy or the other alternatives presented, if used, would transfer contaminants into the air and affect the health of local residents.

RESPONSE: During the Remedial Design of the Site Remedy, EPA will conduct extensive research to determine the volume of contaminants expected to be withdrawn by the selected technologies. The remedy will then be designed to include sufficient treatment of any contaminated air removed through the soil vapor extraction and sparging. This may include using a carbon filter which will absorb solvents prior to dispersing the air from the system. The carbon filter would be replaced and disposed of on a regular basis during treatment.

COMMENT#4: A huge volume of chemicals are now produced commercially and only a small percentage of those have any health data available. How can EPA be confident in their ability to make health based decisions on the contaminants?

RESPONSE: The chemicals of concern at the LCC Site have been available commercially for many years and include common metals and solvents. Health-based data is available for most of these chemicals. For any data gaps, i.e. - small pieces of data which may not be available for a particular chemical, EPA requires in the site risk assessment that very conservative assumptions be used based on documented risk assessment techniques.

COMMENT #5: What is your timetable from now on? Will something be physically done at the Site within six months?

RESPONSE: The public comment period closes on April 20, 2001, after which EPA will review the comments received and, if no changes to the Remedy are made based on the comments, EPA will finalize the Record of Decision for the Selected Remedy. After the ROD is final, EPA will negotiate the time-frame for the Remedial Design and Remedial Action with the PRPs. This time-frame will become legally binding through a Judicial Consent Decree. The Consent Decree will contain the Statement of Work which the PRP will perform. The time-frame will vary based on the amount of data to be gathered to complete a design, the technical complexity of a given remedy, and the outcome of PRP negotiations.

PRP Contractor Comments and USEPA Responses:

COMMENT #1: The data and Feasibility Study evaluation criteria do not support the inclusion of a deep groundwater zone remedy in the remedial actions at the site at this time. If deep groundwater conditions were to change in such a way as to significantly increase the risk of off-site exposure, the barrier may be an appropriate solution to implement at such a time. The deep groundwater zone barrier should be cited in the ROD as a contingency measure. Multiple sequential sampling events and risk assessment tools will be relied upon to make the determination that significant increase in risk has or has not occurred.

RESPONSE: EPA is concerned that off-site ground-water contamination in excess of drinking-water MCLs is present in the deep monitoring zone. Based on the data presented in Table 2B of the Feasibility Study (FS), there is no indication of concentration decreases of key organic contaminants at on-site deep well MW-10D near the southern property boundary, nor are concentration decreases of those key contaminants observed at deep off-site monitoring well MW-17D south of MW-10D. Thus, EPA considers it inappropriate to allow natural attenuation in the down gradient part of the deep zone contaminant plume, combined with source-control actions in the upgradient area of ground-water contamination, to address this off-site contamination problem. This position is supported by the ground-water modeling analysis presented as Appendix A to the FS, which shows some potential for ground-water contamination by PCE to remain above the drinking-water MCL in off-site areas for more than 20 years following source area remedial actions, without any active remedy to address the down gradient ground-water contamination in the bedrock zone. As noted in Table 24 and Table 25 in the FS Report, 30-year cost estimates are presented for the two active remedial options that were considered as viable alternatives to address the deep zone groundwater contamination near the site's southern boundary. EPA believes that actively addressing that contamination would result in attainment of ground-water remedial objectives in that down gradient area in less than 30 years. This more efficient remedial action, while not quantified, should mean that the cost of the Selected Remedy, as well as the costs of the individual Alternatives 3 and 4, will be less than the FS-Report projected costs for these two alternatives. In addition, no institutional controls are available to preclude potential exposure to ground-water in the off-site area of ground-water contamination. Therefore, EPA will retain the more conservative approach. If the remedial goals are achieved prior to the projected time-frames, EPA may determine during a five-year review that the active remediation system in the deeper zone may be discontinued.

COMMENT #2: An addendum to the Feasibility Study will be submitted in June 2001, describing sampling methods, sample locations, analytical procedures, data interpretation procedures, and results of site-specific leach tests for establishing soil remedial goals for groundwater protection.

RESPONSE: EPA agreed that site specific leach tests could useful in establishing the soil remedial goals. EPA will review the methodology and results of the leach tests as presented in the addendum and determine at that time the appropriateness of using any of the site-specific remedial goals. Any remedial goals which are changed as a result of this review will result in either a ROD amendment or an Explanation of Significant Differences which would be added to the Administrative Record for this Site.

COMMENT #3: The shallow sparge remedy should be cited in the ROD as a source area remedy, not, as noted in the Proposed Plan "in-situ sparging (or in-well stripping) for shallow aquifer impacts, *including areas that may be discharging contaminants to Ferry Branch*" (emphasis added by Commentor).

RESPONSE: The FS Report, Section 4.3.3 discussion of Alternative 3, identifies the shallow zone air sparging action as applying to the source areas. Any concern about the Proposed Plan language is addressed in the ROD, which presents the in-situ sparging of the shallow zone as being applied to the source area.

COMMENT #4: The reasonably anticipated use of the property will be either undeveloped or industrial.

RESPONSE: EPA and SCDHEC do not agree with this determination, based on studies of area zoning, and actual development noted around the area in physical surveys of the surrounding communities. As stated in Section F, Current and Potential Future Land and Resource Uses, LCC lies within a Rural Development District, and is bordered by an Industrial Development District. Based on the details of this zoning, and actual residential patterns in the area, there is no reason to assume that the Site will not be developed for residential use. In addition, if the Site is developed for residential use, there is a high likelihood, based on current patterns, of groundwater being used as a drinking water source.

COMMENT #5: The Proposed Plan stated the first two Remedial Action Objectives (RAOs) as "prevent contaminant discharge to Ferry Branch", and "prevent groundwater contamination from migrating beyond the Site boundaries". Revised terminology such as "reduce or eliminate discharge to Ferry Branch" and "reduce or eliminate contaminant migration beyond Site boundaries" better indicates that a period of time will be allowed to meet these objectives using the proposed aggressive source area remedies.

RESPONSE: EPA believes the RAO's as stated are appropriate for EPA's intended goals for the site. It would take an unacceptable amount of time to "reduce or eliminate discharge to Ferry Branch" or "reduce or eliminate contaminant migration beyond site boundaries" if source area remedies alone were used. The RAOs, as stated in the Proposed Plan and this ROD, would be met through installation of a treatment barrier (air sparging or injection of a biodegradation enhancement), restricting contaminated groundwater to the site boundaries, thus having an immediate impact in controlling contaminant migration. The upgradient remedies, including air sparging and vacuum extraction, will take some time to implement and will therefore have delayed benefits in terms of controlling contaminant migration at the site boundary.

APPENDIX A
RISK CHARACTERIZATION SUMMARY

Table 1
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Current
Receptor Population: Site Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
Air	Air	Fugitive Dust Inhalation	Beryllium	2.33E-015			2.33E-015
			Methylene Chloride	1.16E-011			1.16E-011
			Tetrachloroethene	7.49E-011			7.49E-011
			Trichloroethene	1.20E-010			1.20E-010
			1,1,2-Trichloroethane	3.18E-009			3.18E-009
			1,2-Dichlorobenzene	5.00E-011			5.00E-011
AIR CANCER RISK TOTAL:3E-009							
Soil	Surface Soil	Ingestion and Dermal Contact- Former Landfill Area	Arsenic		2.70E-008	1.56E-009	2.86E-008
			Bix(2-thylhexyl)pthalate		1.16E-007	1.13E-007	2.29E-007
			Methylene Chloride		1.59E-010	1.08E-010	2.67E-010
			Arochlor		4.99E-007	5.41E-007	1.04E-006
			Tetrachloroethene		5.90E-009	3.20E-009	9.09E-009
			Trichloroethene		2.83E-010	1.53E-010	4.36E-010
			1,1,2-Trichloroethane		9.48E-009	6.31E-009	1.58E-008
Former Landfill Area - Soil Cancer Risk Total:1E-006							
Soil	Surface Soil	Ingestion and Dermal Contact	Arsenic		1.37E-008	7.94E-010	1.45E-008
			Bis(2-ethylhexyl)phthalate		2.96E-010	2.87E-010	5.83E-010
			Methylene Chloride		9.07E-013	6.17E-013	1.52E-012
			Arochlor		4.54E-009	4.92E-009	9.46E-009
			Tetrachloroethene		2.99E-011	1.62E-011	4.61E-011
Storage Area - Soil Cancer Risk Total: 2E-008							
Soil	Surface Soil	Ingestion and Dermal Contact - Truck Turnaround/Process Area	Arsenic		2.29E-008	1.33E-009	2.42E-008
			Bis(2-ethylhexyl)phthalate		5.50E-007	5.33E-007	1.08E-006
			Methylene Chloride		1.13E-007	7.71E-008	1.90E-007
			Arochlor		3.32E-007	3.61E-007	6.93E-007
			Tetrachloroethene		6.05E-006	3.28E-006	9.33E-006
			Trichloroethene		1.11E-006	6.04E-007	1.72E-006
			1,1,2-Trichloroethane		6.54E-006	4.36E-006	1.09E-005

Table 1
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Current
Receptor Population: Site Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
Truck Turnaround/Process Area - Soil Cancer Risk Total:2E-005							
SOIL CANCER RISK TOTAL:							3E-005
Sediment	Sediment	Dermal Contact with Sediment	Tetrachloroethene			5.82E-012	5.82E-012
			Trichloroethene			3.52E-013	3.52E-013
SEDIMENT CANCER RISK TOTAL:6E-012							
RECEPTOR CANCER RISK:3E-005							

Table 2 Risk Characterization Summary - Carcinogens							
Scenario Timeframe: Future Receptor Age: Adult R eceptor Population: Resident							
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
Air	Air	Fugitive Dust Inhalation	Beryllium	4.64E-014			4.64E-014
			Methylene Chloride	2.30E-010			2.30E-010
			Tetrachloroethene	1.49E-009			1.49E-009
			Trichloroethene	2.38E-009			2.38E-009
			1,1,2-Trichloroethane	6.32E-008			6.32E-008
			1,2-Dichlorobenzene	9.94E-010			9.94E-010
AIR CANCER RISK TOTAL:							7E-008
Soil	Surface Soil	Ingestion and Dermal Contact - All Areas	Arsenic		1.68E-006	9.52E-008	1.77E-006
			Bis(2-ethylhexyl)phthalate		1.71E-005	1.63E-005	3.34E-005
			Methylene Chloride		3.53E-006	2.35E-006	5.88E-006
			Arochlor		3.10E-005	3.30E-005	6.40E-005
			Tetrachloroethene		1.88E-004	1.00E-004	2.88E-004
			Trichloroethene		3.46E-005	1.84E-005	5.31E-005
			1,1,2-Trichloroethane		2.04E-004	1.33E-004	3.37E-004
SOIL CANCER RISK TOTAL:							8E-004
Water	Shallow Groundwater	Inhalation While Showering and Ingestion	Methylene Chloride	7.60E-005	8.46E-004		9.22E-004
			Tetrachloroethene	8.71E-005	5.38E-003		5.46E-003
			Trichloroethene	5.70E-005	2.48E-004		3.05E-004
			Vinyl Chloride	1.60E-004	1.83E-002		1.84E-002
			1,1,2-Trichloroethane	2.17E-003	5.25E-003		7.42E-003
			1,2-Dichloroethene	3.56E-006	2.82E-005		3.18E-005
			1,2-Dichloroethane	2.92E-004	6.93E-004		9.85E-004
Shallow Groundwater Cancer Risk Total:							3E-002
Water	Deep Groundwater	Inhalation While Showering and Ingestion	Methylene Chloride	2.53E-008	2.82E-007		3.07E-007
			Tetrachloroethene	7.92E-006	4.89E-004		4.97E-004
			Trichloroethene	7.60E-006	3.31E-005		4.07E-005
			1,1,2-Trichloroethane	1.73E-005	4.18E-005		5.91E-005
			1,2-Dichloroethene	1.43E-006	1.13E-005		1.27E-005

Table 2 Risk Characterization Summary - Carcinogens							
Scenario Timeframe: Future Receptor Age: Adult R eceptor Population: Resident							
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
				Deep Groundwater Cancer Risk Total:			6E-004
				GROUNDWATER CANCER RISK TOTAL:			3E-002
Sediment	Sediment	Dermal Contact with Sediment	Tetrachloroethene			9.10E-011	9.10E-011
			Trichloroethene			5.50E-012	5.50E-012
				SEDIMENT CANCER RISK TOTAL:			1E-010
				RECEPTOR CANCER RISK:			3E-002

Table 3
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Age: Child
Population: Resident

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
Air	Air	Fugitive Dust Inhalation	Beryllium	3.40E-014			3.40E-014
			Methylene Chloride	1.69E-010			1.69E-010
			Tetrachloroethene	1.09E-009			1.09E-009
			Trichloroethene	1.74E-009			1.74E-009
			1,1,2-Trichloroethane	4.63E-008			4.63E-008
			1,2-Dichlorobenzene	7.29E-010			7.29E-010
						AIR CANCER RISK TOTAL:	5E-008
Soil	Surface Soil	Ingestion and Dermal Contact - All Areas	Arsenic		3.93E-006	1.03E-007	4.03E-006
			Bis(2-ethylhexyl)phthalate		4.00E-005	1.76E-005	5.76E-005
			Methylene Chloride		8.25E-006	2.54E-006	1.08E-005
			Arochlor		7.26E-005	3.56E-005	1.08E-004
			Tetrachloroethene		4.40E-004	1.08E-004	5.49E-004
			Trichloroethene		8.11E-005	1.99E-005	1.01E-004
			1,1,2-Trichloroethane		4.77E-004	1.44E-004	6.20E-004
						SOIL CANCER RISK TOTAL:	1E-003
Water	Shallow Groundwater	Inhalation While Showering and Ingestion	Methylene Chloride	9.22E-005	4.77E-004		5.69E-004
			Tetrachloroethene	1.06E-004	3.03E-003		3.14E-003
			Trichloroethene	6.91E-005	1.40E-004		2.09E-004
			Vinyl Chloride	1.94E-004	1.03E-002		1.05E-002
			1,1,2-Trichloroethane	2.63E-003	2.96E-003		5.59E-003
			1,2-Dichloroethene	4.32E-006	1.59E-005		2.02E-005
			1,2-Dichloroethane	3.54E-004	3.91E-004		7.45E-004
						Shallow Groundwater Cancer Risk Total:	2E-002
Water	Deep Groundwater	Inhalation While Showering and Ingestion	Methylene Chloride	3.07E-008	1.65E-007		1.96E-007
			Tetrachloroethene	9.60E-006	2.86E-004		2.96E-004
			Trichloroethene	9.22E-006	1.94E-005		2.86E-005
			1,1,2-Trichloroethane	2.10E-005	2.45E-005		4.55E-005
			1,2-Dichloroethene	1.73E-006	6.60E-006		8.33E-006

Table 3 Risk Characterization Summary - Carcinogens							
Scenario Timeframe: Future **Receptor Age:** Child **Population:** Resident							
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Concern**	**Carcinogen Risk**			
				Inhalation	**Ingestion**	**Dermal**	**Total Risk**
						Deep Groundwater Cancer Risk Total:	**4E-004**
						GROUNDWATER CANCER RISK TOTAL:	**2E-002**
Sediment	Sediment	Dermal Contact with Sediment	Tetrachloroethene			9.83E-011	9.83E-011
			Trichloroethene			5.94E-012	5.94E-012
						SEDIMENT CANCER RISK TOTAL:	**1E-010**
						RECEPTOR CANCER RISK:	**2E-002**

Table 4
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
Soil	Surface Soil	Ingestion and Dermal Contact - Former Landfill Area	Arsenic		1.57E-007	7.62E-009	1.65E-007
			Bis(2-ethylhexyl)phthalate		6.78E-007	5.50E-007	1.23E-006
			Arochlor		2.90E-006	2.64E-006	5.54E-006
			1,1,2-Trichloroethane		5.52E-008	3.08E-008	8.60E-008
						Former Landfill Area - Soil Cancer Risk Total:	7E-006
Soil	Surface Soil	Ingestion and Dermal Contact - Storage Area	Bis(2-ethylhexyl)phthalate		1.72E-009	1.40E-009	3.12E-009
			Arochlor		2.64E-008	2.40E-008	5.04E-008
						Storage Area - Soil Cancer Risk Total:	5E-008
Soil	Surface Soil	Ingestion and Dermal Contact - Truck Turnaround/Process Area	Bis(2-ethylhexyl)phthalate		3.17E-006	2.60E-006	5.77E-006
			Methylene Chloride		6.53E-007	3.76E-007	1.03E-006
			Arochlor		1.91E-006	1.76E-006	3.67E-006
			Tetrachloroethene		3.48E-005	1.60E-005	5.09E-005
			Trichloroethene		6.41E-006	2.95E-006	9.36E-006
			1,1,2-Trichloroethane		3.77E-005	2.13E-005	5.90E-005
						Truck Turnaround/Process Area - Soil Cancer Risk Total:	1E-004
						SOIL CANCER RISK TOTAL:	1E-004
Water	Shallow Groundwater	Ingestion	Methylene Chloride		3.15E-004		3.15E-004
			Tetrachloroethene		2.00E-003		2.00E-003
			Trichloroethene		9.24E-005		9.24E-005
			Vinyl Chloride		6.80E-003		6.80E-003
			1,1,2-Trichloroethane		1.96E-003		1.96E-003
			1,2-Dichloroethene		1.05E-005		1.05E-005
			1,2-Dichloroethane		2.58E-004		2.58E-004
						Shallow Groundwater Hazard Index Total:	1E-002
Water	Deep Groundwater	Ingestion	Methylene Chloride		1.05E-007		1.05E-007
			Tetrachloroethene		1.82E-004		1.82E-004
			Trichloroethene		1.23E-005		1.23E-005

Table 4 Risk Characterization Summary - Carcinogens							
Scenario Timeframe:	Future						
Receptor Population:	Worker						
Receptor Age:	Adult						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogen Risk			
				Inhalation	Ingestion	Dermal	Total Risk
			1,1,2-Trichloroethane		1.56E-005		1.56E-005
			1,2-Dichloroethene		4.20E-006		4.20E-006
Deep Groundwater Hazard Index Total:							2E-004
GROUNDWATER HAZARD INDEX TOTAL:							1E-002
Sediment	Sediment	Dermal Contact with Sediment	Tetrachloroethene	2.73E-012			2.73E-012
			Trichloroethene	1.65E-013			1.65E-013
SEDIMENT CANCER RISK TOTAL:							3E-012
RECEPTOR CANCER RISK:							1E-002

Table 5
Risk Characterization Summary - Noncarcinogens

Scenario Timeframe: Current
Receptor Population: Site Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
Air	Air	Fugitive Dust Inhalation	Barium	1.72E-008			1.72E-008
			Beryllium	3.41E-016			3.41E-016
			Chromium	7.29E-008			7.29E-008
			Manganese	1.30E-007			1.30E-007
			Mercury	9.35E-012			9.35E-012
			Methyl Ethyl Ketone	3.65E-009			3.65E-009
			Methylene Chloride	5.90E-008			5.90E-008
			Tetrachloroethene	2.38E-006			2.38E-006
			Toluene	1.50E-006			1.50E-006
AIR HAZARD INDEX TOTAL:							**4E-006**
Soil	Surface Soil	Ingestion and Dermal Contact - Former Landfill Area	Acetone		2.12E-006	1.35E-006	3.47E-006
			Antimony		6.89E-003	3.65E-002	4.34E-002
			Arsenic		4.20E-004	2.30E-005	4.43E-004
			Barium		6.84E-004	5.17E-004	1.20E-003
			Beryllium		1.30E-005	6.86E-005	8.16E-005
			Bis(2-ethylhexyl)phthalate		2.91E-003	3.08E-003	5.99E-003
			Cadmium		1.54E-003	1.64E-003	3.18E-003
			Chromium		1.25E-002	3.30E-002	4.55E-002
			Copper		2.02E-005	5.33E-006	2.55E-005
			Di-n-butylphthalate		1.90E-004	2.02E-004	3.92E-004
			Mercury		5.29E-005	1.40E-005	6.69E-005
			Methylene Chloride		2.47E-006	1.63E-006	4.10E-006
			Nickel		4.81E-005	9.44E-006	5.76E-005
			Arochlor		8.73E-002	9.24E-002	1.80E-001
			Tetrachloroethene		7.94E-005	4.20E-005	1.21E-004
			Toluene		3.97E-006	2.63E-006	6.59E-006
			Trichloroethene		3.00E-005	1.59E-005	4.58E-005
			Vanadium		7.13E-004	1.89E-004	9.01E-004
			Zinc		2.66E-005	7.05E-006	3.37E-005

Table 5 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe:	Current						
Receptor Population:	Site Visitor						
Receptor Age:	Adult						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			1,1,2-Trichloroethane		2.91E-004	1.93E-004	4.83E-004
			1,2-Dichlorobenzene		1.23E-004	8.17E-005	2.05E-004
			4-Methylphenol		5.18E-005	5.49E-005	1.07E-004
Former Landfill Area - Soil Hazard Index Total:							3E-001
Soil	Surface Soil	Ingestion and Dermal Contact - Storage Area	Acetone		2.75E-008	1.75E-008	4.51E-008
			Arsenic		2.13E-004	1.17E-005	2.25E-004
			Barium		3.10E-005	2.34E-005	5.44E-005
			Beryllium		1.93E-005	1.20E-004	1.39E-004
			Bis(2-ethylhexyl)phthalate		7.41E-006	7.84E-006	1.52E-005
			Cadmium		5.84E-004	6.18E-004	1.20E-003
			Chromium		1.29E-003	3.40E-003	4.69E-003
			Copper		2.53E-006	6.69E-007	3.20E-006
			Manganese		1.53E-004	1.62E-004	3.16E-004
			Mercury		1.94E-005	5.13E-006	2.45E-005
			Methylene Chloride		1.41E-008	9.33E-009	2.34E-008
			Nickel		1.56E-005	3.06E-006	1.87E-005
			Arochlor		7.94E-004	8.40E-004	1.63E-003
			Tetrachloroethene		4.02E-007	2.13E-007	6.15E-007
			Toluene		2.91E-009	1.93E-009	4.83E-009
			Vanadium		1.24E-003	3.28E-004	1.57E-003
			Zinc		1.13E-005	3.00E-006	1.43E-005
Storage Area - Soil Hazard Index Total:							1E-002
Soil	Surface Soil	Ingestion and Dermal Contact - Truck Turnaround/ Process Area	Acetone		1.80E-008	1.15E-008	2.95E-008
			Antimony		2.25E-001	1.19E+000	1.42E+000
			Arsenic		3.57E-004	1.95E-005	3.76E-004
			Barium		6.69E-004	5.05E-004	1.17E-003
			Beryllium		3.71E-005	1.96E-004	2.33E-004

Table 5 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe:	Current						
Receptor Population:	Site Visitor						
Receptor Age:	Adult						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			Bis(2-ethylhexyl)phthalate		1.38E-002	1.46E-002	2.83E-002
			Cadmium		2.04E-002	2.15E-002	4.19E-002
			Chromium		2.78E-002	7.35E-002	1.01E-001
			Copper		3.48E-004	9.18E-005	4.40E-004
			Di-n-butylphthalate		8.06E-005	8.51E-005	1.66E-004
			Manganese		2.87E-004	3.03E-004	5.90E-004
			Mercury		7.77E-005	2.05E-005	9.83E-005
			Methyl Ethyl Ketone		8.48E-004	5.60E-004	1.41E-003
			Methylene Chloride		1.77E-003	1.17E-003	2.93E-003
			Nickel		4.97E-003	9.73E-004	5.94E-003
			Arochlor		5.83E-002	6.16E-002	1.20E-001
			Tetrachloroethene		8.16E-002	4.31E-002	1.25E-001
			Toluene		1.17E-002	7.70E-003	1.94E-002
			Trichloroethene		1.18E-001	6.25E-002	1.81E-001
			Vanadium		1.65E-003	4.36E-004	2.09E-003
			Zinc		3.40E-004	8.98E-005	4.30E-004
			1,1,2-Trichloroethane		2.01E-001	1.33E-001	3.34E-001
			1,2-Dichlorobenzene		1.65E-004	1.09E-004	2.74E-004
			4-Methylphenol		7.63E-005	8.06E-005	1.57E-004
Truck Turnaround/Process Area - Soil Hazard Index Total:							2E+000
SOIL HAZARD INDEX TOTAL:							3E+000
Sediment	Sediment	Dermal Contact with Sediment	Barium			1.07E-005	1.07E-005
			Chromium			4.89E-004	4.89E-004
			Copper			1.28E-007	1.28E-007
			Manganese			7.97E-005	7.97E-005
			Nickel			1.91E-006	1.91E-006
			Tetrachloroethene			7.84E-008	7.84E-008
			Toluene			1.40E-009	1.40E-009

Table 5 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe:	Current						
Receptor Population:	Site Visitor						
Receptor Age:	Adult						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			Trichloroethene			3.73E-008	3.73E-008
			Vanadium			3.10E-005	3.10E-005
			Zinc			1.76E-006	1.76E-006
				SEDIMENT HAZARD INDEX TOTAL:			6E-004
				RECEPTOR HAZARD INDEX:			3E+00

Table 6
Risk Characterization Summary - Noncarcinogens

Scenario Timeframe: Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
Soil	Surface Soil	Ingestion and Dermal Contact - Former Landfill Area	Antimony		1.56E-002	7.29E-002	8.86E-002
			Arsenic		9.52E-004	4.60E-005	9.98E-004
			Barium		1.55E-003	1.03E-003	2.59E-003
			Bis(2-ethylhexyl)phthalate		6.60E-003	6.16E-003	1.28E-002
			Cadmium		3.50E-003	3.27E-002	3.62E-002
			Chromium		2.83E-002	6.61E-002	9.44E-002
			Copper		4.57E-005	1.07E-005	5.64E-005
			Di-n-butylphthalate		4.32E-004	4.03E-004	8.35E-004
			Arochlor		1.98E-001	1.85E-001	3.83E-001
			1,1,2-Trichloroethane		6.60E-004	3.85E-004	1.05E-003
Former Landfill Area - Soil Hazard Index Total:							**6E-001**
Soil	Surface Soil	Ingestion and Dermal Contact - Storage Area	Barium		7.03E-005	4.69E-005	1.17E-004
			Bis(2-ethylhexyl)phthalate		1.68E-005	1.57E-005	3.25E-005
			Cadmium		1.32E-003	1.24E-003	2.56E-003
			Chromium		2.92E-003	6.80E-003	9.72E-003
			Mercury		4.40E-005	1.03E-005	5.43E-005
			Arochlor		1.80E-003	1.68E-003	3.48E-003
			Vanadium		2.81E-003	6.56E-004	3.47E-003
Storage Area - Soil Hazard Index Total:							**2E-002**
Soil	Surface Soil	Ingestion and Dermal Contact - Truck Turnaround/Process Area	Antimony		5.10E-001	2.34E+000	2.85E+000
			Bis(2-ethylhexyl)phthalate		3.12E-002	2.86E-002	5.98E-002
			Cadmium		4.61E-002	4.22E-002	8.83E-002
			Chromium		6.30E-002	1.44E-001	2.08E-001
			Copper		7.87E-004	1.80E-004	9.68E-004
			Methyl Ethyl Ketone		1.92E-003	1.10E-003	3.02E-003

Table 6 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe: Future Receptor Population: Worker Receptor Age: Adult							
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			Methylene Chloride		4.00E-003	2.29E-003	6.29E-003
			Arochlor		1.32E-001	1.21E-001	2.53E-001
			Tetrachloroethene		1.85E-001	8.47E-002	2.70E-001
			Toluene		2.64E-002	1.51E-002	4.15E-002
			Trichloroethene		2.68E-001	1.23E-001	3.91E-001
			1,1,2-Trichloroethane		4.56E-001	2.61E-001	7.17E-001
Truck Turnaround/Process Area - Soil Hazard Index Total:							5E+000
SOIL HAZARD INDEX TOTAL:							6E+000
Water	Shallow Groundwater	Ingestion	Acetone		2.65E+000		2.65E+000
			Manganese		6.24E-001		6.24E-001
			Methyl Ethyl Ketone		2.29E+000		2.29E+000
			Methylene Chloride		1.96E+000		1.96E+000
			Methyl Isobutyl Ketone		1.59E+000		1.59E+000
			Tetrachloroethene		1.08E+001		1.08E+001
			Toluene		8.82E-001		8.82E-001
			Trichloroethene		3.92E+000		3.92E+000
			Vinyl Chloride		8.82E+000		8.82E+000
			Zinc		5.06E-003		5.06E-003
			1,1,2-Trichloroethane		2.40E+001		2.40E+001
			1,2-Dichloroethene		5.44E-003		5.44E-003
			1,2-Dichloroethane		2.65E-001		2.65E-001
Shallow Groundwater Hazard Index Total:							6E+001
Water	Deep Groundwater	Ingestion	Manganese		1.49E-002		1.49E-002
			Methylene Chloride		6.53E-004		6.53E-004
			Tetrachloroethene		9.80E-001		9.80E-001
			Trichloroethene		5.23E-001		5.23E-001

Table 6 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe: Future Receptor Population: Worker Receptor Age: Adult							
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			1,1,2-Trichloroethane		1.91E-001		1.91E-001
			1,2-Dichloroethene		2.18E-003		2.18E-003
Deep Groundwater Hazard Index Total:							2E+000
GROUNDWATER HAZARD INDEX TOTAL:							6E+001
Sediment	Sediment	Dermal Contact with Sediment	Nickel			3.58E-007	3.58E-007
			Tetrachloroethene			1.47E-008	1.47E-008
			Trichloroethene			7.00E-009	7.00E-009
			Zinc			3.30E-007	3.30E-007
SEDIMENT HAZARD INDEX TOTAL:							7E-007
RECEPTOR HAZARD INDEX:							7E+001

Table 7 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe:	**Future**						
Receptor Population:	**Resident**						
Resident Receptor Age:	**Adult**						
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Concern**	**Noncarcinogen Hazard Quotient**			
				Inhalation	**Ingestion**	**Dermal**	**Total Risk**
Air	Air	Fugitive Dust Inhalation	Barium	1.10E-007			1.10E-007
			Beryllium	2.18E-015			2.18E-015
			Chromium	4.66E-007			4.66E-007
			Manganese	8.29E-007			8.29E-007
			Mercury	5.97E-011			5.97E-011
			Methyl Ethyl Ketone	2.33E-008			2.33E-008
			Methylene Chloride	3.77E-007			3.77E-007
			Tetrachloroethene	1.52E-005			1.52E-005
			Toluene	9.57E-006			9.57E-006
				AIR HAZARD INDEX TOTAL:			**3E-005**
Soil	Surface Soil	Ingestion and Dermal Contact - All Areas	Acetone		5.60E-005	3.52E-005	9.12E-005
			Antimony		2.98E+000	1.55E+001	1.85E+001
			Arsenic		1.11E-002	5.99E-004	1.17E-002
			Barium		8.84E-003	6.58E-003	1.54E-002
			Bis(2-ethylhexyl)phthalate		1.82E-001	1.90E-001	3.72E-001
			Cadmium		2.69E-001	2.80E-001	5.49E-001
			Chromium		3.68E-001	9.59E-001	1.33E+000
			Copper		4.59E-003	1.20E-003	5.79E-003
			Di-n-butylphthalate		5.04E-003	5.26E-003	1.03E-002
			Manganese		6.83E-003	7.12E-003	1.40E-002
			Mercury		1.40E-003	3.65E-004	1.77E-003
			Methyl Ethyl Ketone		1.12E-002	7.30E-003	1.85E-002
			Methylene Chloride		2.33E-002	1.52E-002	3.85E-002
			Nickel		6.57E-002	1.27E-002	7.83E-002
			Arochlor		2.31E+000	2.41E+000	4.72E+000
			Tetrachloroethene		1.08E+000	5.62E-001	1.64E+000
			Toluene		1.54E-001	1.00E-001	2.54E-001

Table 7 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe:	Future						
Receptor Population:	Resident						
Resident Receptor Age:	Adult						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			Trichloroethene		1.56E+000	8.15E-001	2.38E+000
			Vanadium		3.28E-002	8.55E-003	4.14E-002
			Zinc		4.49E-003	1.17E-003	5.66E-003
			1,1,2-Trichloroethane		2.66E+000	1.73E+000	4.39E+000
					SOIL HAZARD INDEX TOTAL:		3E+001
Water	Shallow Groundwater	Inhalation While Showering and Ingestion	Acetone		7.29E+000		7.29E+000
			Manganese		1.72E+000		1.72E+000
			Methyl Ethyl Ketone	5.60E+000	6.30E+000		1.19E+001
			Methylene Chloride	1.62E-001	5.40E+000		5.56E+000
			Methyl Isobutyl Ketone	6.56E+000	4.39E+000		1.09E+001
			Tetrachloroethene	1.16E+000	2.97E+001		3.09E+001
			Toluene	1.90E+000	2.43E+000		4.33E+000
			Trichloroethene		1.08E+001		1.08E+001
			Zinc		1.40E-002		1.40E-002
			1,1,2-Trichloroethane		6.62E+001		6.62E+001
			1,2-Dichloroethene		1.50E-002		1.50E-002
			1,2-Dichloroethane		7.29E-001		7.29E-001
				Shallow Groundwater Hazard Index Total:			2E+002
Water	Deep Groundwater	Inhalation While Showering and Ingestion	Manganese		4.11E-002		4.11E-002
			Methylene Chloride	5.40E-005	1.80E-003		1.85E-003
			Tetrachloroethene	1.05E-001	2.70E+000		2.81E+000
			Trichloroethene		1.44E+000		1.44E+000
			1,1,2-Trichloroethane		5.27E-001		5.27E-001
			1,2-Dichloroethene		6.00E-003		6.00E-003
				Deep Groundwater Hazard Index Total:			5E+000
				GROUNDWATER HAZARD INDEX TOTAL:			2E+002

Table 7 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe:	Future						
Receptor Population:	Resident						
Resident Receptor Age:	Adult						
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
Sediment	Sediment	Dermal Contact with Sediment	Barium			7.00E-005	7.00E-005
			Chromium			3.19E-003	3.19E-003
			Copper			8.32E-007	8.32E-007
			Manganese			5.19E-004	5.19E-004
			Nickel			1.24E-005	1.24E-005
			Tetrachloroethene			5.11E-007	5.11E-007
			Toluene			9.13E-009	9.13E-009
			Trichloroethene			2.43E-007	2.43E-007
			Vanadium			2.02E-004	2.02E-004
			Zinc			1.15E-005	1.15E-005
SEDIMENT HAZARD INDEX TOTAL:							4E-003
RECEPTOR HAZARD INDEX:							2E+002

Table 8 Risk Characterization Summary - Noncarcinogens							
Scenario Timeframe: Future Receptor Population: Resident Receptor Age: Child							
Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
Air	Air	Fugitive Dust Inhalation	Barium	4.07E-007			4.07E-007
			Beryllium	8.06E-015			8.06E-015
			Chromium	1.72E-006			1.72E-006
			Manganese	3.07E-006			3.07E-006
			Mercury	2.21E-010			2.21E-010
			Methyl Ethyl Ketone	8.62E-008			8.62E-008
			Methylene Chloride	1.40E-006			1.40E-006
			Tetrachloroethene	5.64E-005			5.64E-005
			Toluene	3.55E-005			3.55E-005
AIR HAZARD INDEX TOTAL:							1E-004
Soil	Surface Soil	Ingestion and Dermal Contact - All Areas	Acetone		5.20E-004	1.54E-004	6.74E-004
			Antimony		2.76E+001	6.80E+001	9.56E+001
			Arsenic		1.03E-001	2.63E-003	1.06E-001
			Barium		8.21E-002	2.89E-002	1.11E-001
			Bis(2-ethylhexyl)phthalate		1.69E+000	8.32E-001	2.52E+000
			Cadmium		2.50E+000	1.23E+000	3.72E+000
			Chromium		3.41E+000	4.20E+000	7.62E+000
			Copper		4.26E-002	5.25E-003	4.79E-002
			Di-n-butylphthalate		4.68E-002	2.30E-002	6.98E-002
			Manganese		6.34E-002	3.12E-002	9.46E-002
			Mercury		1.30E-002	1.60E-003	1.46E-002
			Methyl Ethyl Ketone		1.04E-001	3.20E-002	1.36E-001
			Methylene Chloride		2.17E-001	6.67E-002	2.83E-001
			Nickel		6.10E-001	5.56E-002	6.65E-001
			Arochlor		2.15E+001	1.06E+001	3.20E+001
			Tetrachloroethene		1.00E+001	2.46E+000	1.25E+001
			Toluene		1.43E+000	4.40E-001	1.87E+000

Table 8
Risk Characterization Summary - Noncarcinogens

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
			Trichloroethene		1.45E+001	3.57E+000	1.81E+001
			Vanadium		3.05E-001	3.75E-002	3.42E-001
			Zinc		4.17E-002	5.13E-003	4.68E-002
			1,1,2-Trichloroethane		2.47E+001	7.60E+000	3.23E+001
				SOIL HAZARD INDEX TOTAL:			**2E+002**
Water	Shallow Groundwater	Inhalation While Showering and Ingestion	Acetone		1.73E+001		1.73E+001
			Manganese		4.08E+000		4.08E+000
			Methyl Ethyl Ketone	2.51E+001	1.49E+001		4.00E+001
			Methylene Chloride	7.26E-001	1.28E+001		1.35E+001
			Methyl Isobutyl Ketone	2.94E+001	1.04E+001		3.98E+001
			Tetrachloroethene	5.20E+000	7.04E+001		7.56E+001
			Toluene		5.76E+000		5.76E+000
			Trichloroethene	8.51E+000	2.56E+001		3.41E+001
			Vinyl Chloride		5.76E+001		5.76E+001
			Zinc		3.31E-002		3.31E-002
			1,1,2-Trichloroethane		1.57E+002		1.57E+002
			1,2-Dichloroethene		3.56E-002		3.56E-002
			1,2-Dichloroethane		1.73E+000		1.73E+000
				Shallow Groundwater Hazard Index Total:			**4E+002**
Water	Deep Groundwater	Inhalation While Showering and Ingestion	Manganese		9.74E-002		9.74E-002
			Methylene Chloride	2.42E-004	4.27E-003		4.51E-003
			Tetrachloroethene	4.73E-001	6.40E+000		6.87E+000
			Trichloroethene		3.41E+000		3.41E+000
			1,1,2-Trichloroethane		1.25E+000		1.25E+000
			1,2-Dichloroethene		1.42E-002		1.42E-002
				Deep Groundwater Hazard Index Total:			**1E+001**
				GROUNDWATER HAZARD INDEX TOTAL:			**5E+002**

Table 8
Risk Characterization Summary - Noncarcinogens

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Noncarcinogen Hazard Quotient			
				Inhalation	Ingestion	Dermal	Total Risk
Sediment	Sediment	Dermal Contact with Sediment	Barium			3.07E-004	3.07E-004
			Chromium			1.40E-002	1.40E-002
			Copper			3.65E-006	3.65E-006
			Manganese			2.28E-003	2.28E-003
			Nickel			5.45E-005	5.45E-005
			Tetrachloroethene			2.24E-006	2.24E-006
			Toluene			4.00E-008	4.00E-008
			Trichloroethene			1.07E-006	1.07E-006
			Vanadium			8.85E-004	8.85E-004
			Zinc			5.03E-005	5.03E-005
				SEDIMENT HAZARD INDEX TOTAL:			2E-002
				RECEPTOR HAZARD INDEX:			7E+002

APPENDIX B
DETAILED COST ANALYSIS OF SELECTED REMEDY

TABLE 1 : CAPITAL COST SUMMARY
Selected Remedy (Modified Alternative #4)

Description	Unit	Unit Cost	Amount	Cost
1. Site Preparation				
Mobilization/demobilization	lump	$4,000	1	$4,000
Clear and grub	acre	$6,000	5	$30,000
Site prep	lump	$5,000	1	$8,000
		Site Preparation Subtotal		$42,000
2. Excavation and Off-Site Disposal of Surface Soil				
Excavation	ton	$15	470	$7,050
Transportation	ton	$60	470	$28,200
Surface soil stabilization	ton	$120	470	$56,400
TCLP soil samples	each	$950	15	$14,250
Backfill placement	ton	$25	470	$11,750
Gravel surface	ton	$15	250	$3,750
Seed/straw/fertilize	acre	$3,000	5	$15,000
Construction oversight	man weeks	$6,200	2	$12,400
Planning and design	lump sum	$18,000	1	$18,000
Permitting/paperwork	lump sum	$9,000	1	$9,000
		Excavation and Off-Site Disposal Subtotal		$175,800
3. Soil Vapor Extraction System				
Soil vapor extraction system	lump sum	$45,000	1	$45,000
2" stainless steel well	each	$2,100	18	$37,800
Trenching/piping system	linear foot	$25	1800	$45,000
Well vault and assembly	each	$1,800	18	$32,400
Skid/concrete pad	lump sum	$3,000	1	$3,000
Heated/insulated shed	each	$12,000	1	$12,000
Civil/mechanical installation	lump sum	$18,000	1	$18,000
Electrical installation	lump sum	$8,000	1	$8,000
Accumulation tank and controls	each	$6,000	1	$6,000
Off-gas carbon treatment system	lump sum	$8,000	1	$8,000
Construction oversight	man weeks	$8,200	6	$49,200
Trench soil disposal	ton	$520	590	$306,800
Engineering and design	fixed %	30% capital equipmnt	-	$64,560
Permitting	fixed %	10% capital equipmnt	-	$21,520
Start-up	fixed %	10% capital equipmnt	-	21,520
		Soil Vapor Extraction System Subtotal		$678,800

TABLE 1 : CAPITAL COST SUMMARY
Selected Remedy (Modified Alternative #4)

Description	Unit	Unit Cost	Amount	Cost
4a. Shallow Zone Air Sparging System				
Air sparging system	lump sum	$24,000	1	$24,000
1" stainless steel well	each	$3,200	21	$67,200
Trenching/piping system	linear foot	$25	1575	$39,375
Well vault and assembly	each	$1,800	21	$37,800
Skid/concrete pad	lump sum	$2,000	1	$2,000
Heated/insulated shed	each	$8,000	1	$8,000
Civil/mechanical installation	lump sum	$18,000	1	$18,000
Electrical installation	lump sum	$8,000	1	$8,000
Construction oversight	man weeks	$8,200	6	$49,200
Trench soil disposal	ton	$520	512	266,240
Engineering and design	fixed %	30% capital equipmnt	-	$61,313
Permitting	fixed %	10% capital equipmnt	-	$20,438
Start-up	fixed %	10% capital equipmnt	-	$20,438
	Shallow Zone Air Sparge System Subtotal			$622,004
4b. Shallow Zone Nitrogen Sparging System				
Sparging pump/valve	lump sum	$24,000	1	$24,000
1" stainless steel well	each	$3,200	21	$67,200
Trenching/piping system	linear foot	$25	1575	$39,375
Well vault and assembly	each	$1,800	21	$37,800
Skid/concrete pad	lump sum	$2,000	1	$2,000
Heated/insulated shed	each	$8,000	1	$8,000
Civil/mechanical installation	lump sum	$18,000	1	$18,000
Electrical installation	lump sum	$8,000	1	$8,000
Nitrogen tank foundation	lump sum	$10,000	1	$10,000
Construction oversight	man weeks	$8,200	6	$49,200
Trench soil disposal	ton	$520	512	$266,240
Engineering and design	fixed %	30% capital equipmnt	-	$64,313
Permitting	fixed %	10% capital equipmnt	-	$21,438
Start-up	fixed %	10% capital equipmnt	-	$21,438
	Shallow Zone Nitrogen Sparge System Subtotal			$637,004
5a. Bedrock Zone HRC Fence (Config. #2)				
Stainless steel injection well	each	$5,462	20	$109,231
Well vault and assembly	each	$1,200	20	$24,000
HRC product	pounds	$11	3200	$35,200
HRC initial injection	day	$3,500	5	$17,500
Engineering and design	fixed %	10% capital equipmnt	-	$18,593
Construction oversight	man weeks	$8,200	8	$65,600
Permitting	fixed %	20% capital equipmnt	-	$37,186
Start-up	-	-	0	$0
	Bedrock Zone HRC Fence Subtotal			$307,310

TABLE 1 : CAPITAL COST SUMMARY
Selected Remedy (Modified Alternative #4)

Description	Unit	Unit Cost	Amount	Cost
5b. Bedrock Zone Air Sparge System				
Air sparging system	lump sum	$18,000	1	$18,000
1" stainless steel well	each	$4,500	6	$27,000
Trenching/piping system	linear foot	$25	250	$6,250
Well vault and assembly	each	$1,800	6	$10,800
Skid/concrete pad	lump sum	$2,000	1	$2,000
Heated/insulated shed	each	$5,000	1	$5,000
Civil/mechanical installation	lump sum	$9,000	1	$9,000
Electrical installation	lump sum	$8,000	1	$8,000
Construction oversight	man weeks	$9,200	4	$36,800
Trench soil disposal	ton	$520	80	$41,600
Engineering and design	fixed %	30% capital equipmnt	-	$25,815
Permitting	fixed %	10% capital equipmnt	-	$16,600
Start-up	fixed %	10% capital equipmnt	-	$16,600
	Bedrock Zone Air Sparge System Subtotal			$223,465
Capital Cost (using 4a & 5a)				$1,825,914
Capital Cost (using 4b & 5b)				$1,757,069
Capital Cost (using 4a & 5b)				$1,742,069
Capital Cost (using 4b & 5a)				$1,840,914

TABLE 2 : OPERATIONS AND MAINTENANCE COST SUMMARY Selected Remedy (Modified Alternative #4)				
Description	**Unit**	**Unit Cost**	**Amount**	**Cost**
1. General (Soil Vapor Extraction & Air Sparge System)				
Weekly O and M	lump sum	$700	52	$36,400
Troubleshooting visits	lump sum	$1,500	8	$12,000
Project management	lump sum	$500	12	$6,000
Auto-dialer phone line	lump sum	$50	12	$600
	General O&M Subtotal			$55,000
2. Excavation and Off-Site Disposal of Surface Soil				
Long-term erosion control	per year	$5,000	1	$5,000
	Excavation and Off-Site Disposal Subtotal			$5,000
3. Soil Vapor Extraction System				
Monthly off-gas sampling	lump sum	$500	12	$6,000
Semi-annual vapor well sampling	lump sum	$6,000	2	$12,000
Annual soil sampling & reporting	lump sum	$15,000	1	$15,000
Condensate disposal (accumulation tank)	lump sum	$6,000	4	$24,000
Equipment replacement	lump sum	$45,000	0.2	$9,000
Off-gas carbon replacement	lump sum	$2,000	6	$12,000
Utilities	lump sum	$420	12	$5,040
	Soil Vapor Extraction System Subtotal			$83,040
4a. Shallow Zone Air Sparge System				
Equipment replacement (assumes every 5 years)	lump sum	$24,000	0.2	$4,800
Utilities	lump sum	$1,391	1	$16,692
	Shallow Zone Air Sparging System Subtotal			$21,492
4b. Shallow Zone Nitrogen Sparge System				
Nitrogen tank	per month	$8,000	12	$96,000
Equipment replacement (assumes every 5 years)	lump sum	$24,000	0.2	$4,800
Utilities	lump sum	$1,391	12	$16,692
	Shallow Zone Nitrogen Sparging System Subtotal			$117,492
5a. Bedrock Zone HRC Fence (Config. #2)				
HRC product re-application	pounds	$11	3200	$35,200
HRC re-application oversight	lump sum	$3,500	1	$3,500
Project management	lump sum	$500	12	$6,000
HRC injection	day	$3,500	5	$17,500
	Bedrock Zone HRC Fence Subtotal			$ 62,200
5b. Bedrock Zone Air Sparge System				

TABLE 2 : OPERATIONS AND MAINTENANCE COST SUMMARY Selected Remedy (Modified Alternative #4)				
Description	**Unit**	**Unit Cost**	**Amount**	**Cost**
Equipment replacement (assumes every 5 years)	lump sum	$18,000	0.2	$3,600
Utilities	lump sum	$630	12	$7,560
	Bedrock Zone Air Sparge System Subtotal			$11,160
O & M Cost (using 4a & 5a)				**$226,732**
O & M Cost (using 4b & 5b)				**$271,692**
O & M Cost (using 4a & 5b)				**$175,692**
O & M Cost (using 4b & 5a)				**$322,732**

TABLE 3 : ANNUAL COST OF GROUNDWATER MONITORING Selected Remedy (Modified Alternative #4)				
Description	**Unit**	**Unit Cost**	**Amount**	**Cost**
1. Annual Cost of Quarterly Groundwater Monitoring (Years 1-10)				
Quarterly GW monitoring	lump sum	$18,375	4	$73,500
55-gallon drums	each	$50	48	$2,400
O&M waste stream disposal				
hazardous	drum	$600	30	$18,000
non-hazardous	drum	$80	16	$1,280
Annual Cost of Quarterly Groundwater Monitoring (Years 1-10)				**$95,180**
2. Annual cost of Semi-Annual Groundwater Monitoring (Years 11-40)				
Semi-Annual Groundwater Monitoring	lump sum	$21,000	2	$42,000
55-gallon drums	each	$50	24	$1,200
O&M waste stream disposal				
hazardous	drum	$600	16	$9,600
non-hazardous	drum	$80	8	$640
Annual Cost of Semi-Annual Groundwater Monitoring (Years 11-40)				**$94,020**

Table 4 Notes and Assumptions for Cost Estimate of Selected Remedy	
1. General	1. All air sparge system costs include inlet air filter, air compressor package, discharge coalescing filter, discharge particulate filter, pressure relief valve, pressure regulator and discharge piping. 2. All air sparge system air compressor packages include rotary screw air compressor & motor, after cooler, 120-gallon receiver, pressure and low oil switches and PLC based controller. 3. Equipment replacement costs based on total cost of capital equipment which could require replacement.
2. Excavation and Off-Site Disposal of Surface Soil	1. Refer to Section 2.4 of Feasibility Study for soil volumes. 2. Cost assumes volatile organics have been remediated prior to stabilization.
3. Soil Vapor Extraction System	1. Assumes 2" stainless steel wells to average depth of 20' with 5 feet of 10 slot screen. 2. Capital equipment costs based on assumption of 18 wells at 5 CFM/well, or 90 CFM total. 3. Vapor extraction system includes liquid/vapor separator, automatic pump out package, air dilution valve assembly, in-line air filter, blower w/explosion-proof motor, duct package, and control and instrumentation package. 4. Automatic separator pump out package includes self-priming pump close w/explosion-proof motor, pipe & fittings, check valve, ball valves, pressure gauge and sample port. 5. Utility cost based on 10 hp running approx. 7900 hours per year (90%) at 8 cents per kw hour.
4a. Shallow Zone Air Sparge System	1.Top of bedrock in vicinity of wells varies from approx 75'-85' below ground surface (bgs); depth to water varies from approx. 20'-30' bgs. 2. Assumes 1' stainless steel wells to average depth of 65' with 2 feet of 10 slot screen. 3. Capital equipment costs based on assumption of 21 wells at 5 cfm/well, or 80 cfm total @30 psig per well. 4. Utility cost based on 25 hp running approx 7900 hrs per year (90%) at 8 cents per kw hour.
4b. Shallow Zone Nitrogen Sparge System	1. Top of bedrock in vicinity of wells varies from approx. 75'-85' bgs; depth to water varies from approx. 20'-30' bgs. 2. Assumes 1' stainless steel wells to average depth of 65' with 2 feet of 10 slot screen. 3. Capital equipment costs based on assumption of 21 wells at 5 cfm/well, or 80 cfm total@30 psig per well. 4. Utility cost based on 25 hp running approx. 7900 hours per year (90%) at 8 cents per kw hour.
5a. Bedrock Zone HRC Fence (Config. 2)	1. Casing drilling cost assumes 20 wells to average surface casing depth of 40'. 2. Open hole drilling cost assumes 20 wells for an average interval of 40'. 3. HRC injection assumes 20' well at 3.5 lbs/ft.
5b. Bedrock Zone Air Sparge System	1.Top of bedrock in vicinity of wells approx. 42' below ground surface (bgs); depth to water approx. 5' bgs. 2. Assumes 1' stainless steel wells to average depth of 65' with 2 feet of 10 slot screen. 3. Capital equipment costs based on assumption of 6 wells at 2-4 cfm/well, or 12-24 cfm total, @50 psig per well.

Table 5 SUMMARY OF PRESENT WORTH CALCULATIONS - Selected Remedy (Modified Alternative #4) Shallow Zone Annual O & M					
Year	Discount Factor (7%)	Air Sparging Option		Nitrogen Sparging Option	
		Annual O&M Cost	Present Worth	Annual O&M Cost	Present Worth
1	0.935	$21,492	$20,095	$117,492	$109,855
2	0.873	$21,492	$18,763	$117,492	$102,571
3	0.816	$21,492	$17,537	$117,492	$95,873
4	0.763	$21,492	$16,398	$117,492	$89,646
5	0.713	$21,492	$15,324	$117,492	$83,772
6	0.666	$21,492	$14,314	$117,492	$78,250
7	0.623	$21,492	$13,390	$117,492	$73,198
8	0.582	$21,492	$12,508	$117,492	$68,380
Total Present Worth Cost			$128,329	****************	$701,545

Table 6 SUMMARY OF PRESENT WORTH CALCULATIONS - Selected Remedy (Modified Alternative #4) Deep Zone Annual O&M					
Year	Discount Factor (7%)	Air Sparging Option		HRC Option	
		Annual O&M Cost	Present Worth	Annual O&M Cost	Present Worth
1	0.935	$11,160	$10,435	$62,200	$58,157
2	0.873	$11,160	$9,743	$62,200	$54,301
3	0.816	$11,160	$9,107	$62,200	$50,755
4	0.763	$11,160	$8,515	$62,200	$47,459
5	0.713	$11,160	$7,957	$62,200	$44,349
6	0.666	$11,160	$7,433	$62,200	$41,425
7	0.623	$11,160	$6,953	$62,200	$38,751
8	0.582	$11,160	$6,495	$62,200	$36,200
9	0.544	$11,160	$6,071	$62,200	$33,837

Table 6 SUMMARY OF PRESENT WORTH CALCULATIONS - Selected Remedy (Modified Alternative #4) Deep Zone Annual O&M					
Year	Discount Factor (7%)	Air Sparging Option		HRC Option	
		Annual O&M Cost	Present Worth	Annual O&M Cost	Present Worth
10	0.508	$11,160	$5,669	$62,200	$31,598
11	0.475	$11,160	$5,301	$62,200	$29,545
12	0.444	$11,160	$4,955	$62,200	$27,617
13	0.415	$11,160	$4,631	$62,200	$25,813
14	0.388	$11,160	$4,330	$62,200	$24,134
15	0.362	$11,160	$4,040	$62,200	$22,516
16	0.338	$11,160	$3,772	$62,200	$21,024
17	0.316	$11,160	$3,527	$62,200	$19,655
18	0.296	$11,160	$3,303	$62,200	$18,411
19	0.277	$11,160	$3,091	$62,200	$17,229
20	0.258	$11,160	$2,879	$62,200	$16,048
21	0.242	$11,160	$2,701	$62,200	$15,052
22	0.226	$11,160	$2,522	$62,200	$14,057
23	0.211	$11,160	$2,355	$62,200	$13,124
24	0.197	$11,160	$2,199	$62,200	$12,253
25	0.184	$11,160	$2,053	$62,200	$11,445
26	0.172	$11,160	$1,920	$62,200	$10,698
27	0.161	$11,160	$1,797	$62,200	$10,014
28	0.150	$11,160	$1,674	$62,200	$9,330
29	0.141	$11,160	$1,574	$62,200	$8,770
30	0.131	$11,160	$1,462	$62,200	$8,148
Total Present Worth Cost			$138,462	****************	$771,715

Table 7 SUMMARY OF PRESENT WORTH CALCULATIONS - Selected Remedy (Modified Alternative #4) Groundwater Monitoring Annual O & M				
Year	Discount Factor (7%)	Quarterly Groundwater Monitoring	Semi-Annual Groundwater Monitoring	Present Worth
2	0.873	$95,180	N/A	$83,092
3	0.816	$95,180	N/A	$77,667
4	0.763	$95,180	N/A	$72,622
5	0.713	$95,180	N/A	$67,863
6	0.666	$95,180	N/A	$63,390
7	0.623	$95,180	N/A	$59,297
8	0.582	$95,180	N/A	$55,395
9	0.544	$95,180	N/A	$51,778
10	0.508	$95,180	N/A	$48,351
Total Present Worth Cost for Quarterly Groundwater Monitoring				$579,456
11	0.475	N/A	$53,440	$25,384
12	0.444	N/A	$53,440	$23,727
13	0.415	N/A	$53,440	$22,178
14	0.388	N/A	$53,440	$20,735
15	0.362	N/A	$53,440	$19,345
16	0.338	N/A	$53,440	$18,063
17	0.316	N/A	$53,440	$16,887
18	0.296	N/A	$53,440	$15,818
19	0.277	N/A	$53,440	$14,803
20	0.258	N/A	$53,440	$13,788
21	0.242	N/A	$53,440	$12,932
22	0.226	N/A	$53,440	$12,077
23	0.211	N/A	$53,440	$11,276
24	0.197	N/A	$53,440	$10,528
25	0.184	N/A	$53,440	$9,833
26	0.172	N/A	$53,440	$9,192

Table 7
SUMMARY OF PRESENT WORTH CALCULATIONS - Selected Remedy (Modified Alternative #4)
Groundwater Monitoring Annual O & M

Year	Discount Factor (7%)	Quarterly Groundwater Monitoring	Semi-Annual Groundwater Monitoring	Present Worth
27	0.161	N/A	$53,440	$8,604
28	0.150	N/A	$53,440	$8,016
29	0.141	N/A	$53,440	$7,535
30	0.131	N/A	$53,440	$7,001
31	0.123	N/A	$53,440	$6,573
32	0.115	N/A	$53,440	$6,146
33	0.107	N/A	$53,440	$5,718
34	0.100	N/A	$53,440	$5,344
35	0.094	N/A	$53,440	$5,023
36	0.088	N/A	$53,440	$4,703
37	0.082	N/A	$53,440	$4,382
38	0.076	N/A	$53,440	$4,061
39	0.071	N/A	$53,440	$3,794
40	0.067	N/A	$53,440	$3,580
41	0.062	N/A	$53,440	$3,313
42	0.059	N/A	$53,440	$3,153
43	0.054	N/A	$53,440	$2,886
44	0.051	N/A	$53,440	$2,725
45	0.048	N/A	$53,440	$2,565
46	0.044	N/A	$53,440	$2,351
47	0.042	N/A	$53,440	$2,244
48	0.039	N/A	$53,440	$2,084
49	0.036	N/A	$53,440	$1,924
50	0.034	N/A	$53,440	$1,817
Total Present Worth Cost for Semi-Annual Groundwater Monitoring				**$ 362,109**

APPENDIX C
INFORMATION REPOSITORIES

For more information, see the Administrative Record for this Site at the following locations:

York County Library
138 East Black Street
P.O. Box 10032
Rock Hill, SC 29731
Phone: 803/324-3055

U.S. EPA Records Center
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303
Phone: 404/562-8828
Fax: 404/562-8788